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A Study of Fault Management Algorithm and Recover the Faulty Node Using the FNR Algorithms for Wireless Sensor Network

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Abstract - In Wireless Sensor Network every Sensor node having a tendency to shut down ,due to computation power, Hardware Fail, Software Fail, environmental Condition and energy depletion. Fault Tolerance is a major problem in a wireless sensor Network. A Fault Management is key of Network Management. Fault management Algorithms is divided into fault detection, fault diagnosis and fault recovery.The fault detection schemes classified in a two types: Centralized Approach and Distributed Approach.Fault diagnosis is the whole process of fault management. In a Fault Diagnosis cover only three question like where the fault is located,what type of fault it is like node failure,how a fault does occurs. Fault recovery is the last phase of the fault management process. The various algorithms are available for the recover the Faulty Node like FNR Algorithm. The increase the Lifetime of WSN Using Fault Node Recovery Algorithm when Sensor Node is dead. Fault Node Recovery Algorithm it depend on Generic Algorithm and Grade Diffusion Algorithm. The algorithm can result in fewer replacements of sensor nodes and more reused routing paths. This Algorithm also increases the number of active nodes, reduces the rate of data loss and reduced energy consumption.

Keywords-- Wireless sensor networks, Genetic algorithm, Grade diffusion algorithm, Fault Node Recovery Algorithm.

INTRODUCTION:

The wireless sensor network is nothing but collection of Sensor Node organized in a Cooperative Network. Each Sensor Node has Capability to process the data, sense the Data and the transfer there Live Data to Base Station or Data Collection Centre. In Wireless Sensor Network, each Sensor Node has limited Computational Power to process and transfer live Data to Base Station. Sensor In Wireless Sensor Network every Sensor node having a tendency to shut down ,due to computation power, Hardware Fail, Software Fail, environmental Condition and energy depletionFault tolerance is one of the critical issues in WSNs. The existing fault tolerance mechanisms either consume significant extra energy to detect and recover from the failures or need to use additional hardware and software resources. Fault Tolerance is a major problem in a wireless sensor Network. A Fault Management is key of Network Management. Fault management Algorithms is divided into fault detection, fault diagnosis and fault recovery.The fault detection schemes classified in a two types: Centralized Approach and Distributed Approach.Fault diagnosis is the whole process of fault management. In a Fault Diagnosis cover only three question like where the fault is located,what type of fault it is like node failure,how a fault does occurs. Fault recovery is the last phase of the fault management process. The various algorithms are available for the recover the Faulty Node like FNR Algorithm.
The aim is to provide Energy efficient and cost effective communication in Wireless Sensor Networks. The proposed algorithm enhances the lifetime of a sensor nodes when a sensor node is shut down and it depends on Grade diffusion algorithm combined with the genetic algorithm. The algorithm can result are in the replacements of sensor nodes and more reused routing paths. This Algorithm also increases the number of active nodes, reduces the rate of data loss and reduced energy consumption

1. **Fault Management Framework:-**
   Fault Tolerance is a major problem in a wireless sensor Network. A Fault Management is key of Network Management. Fault management Algorithms [10] is divided into fault detection, fault diagnosis and fault recovery.Fault detection schemes classified in a two types: Centralized Approach and Distributed Approach.Fault diagnosis is the whole process of fault management. In a Fault Diagnosis cover only three question like where the fault is located,what type of fault it is like node failure,how does a fault occurs. Fault recovery is the last phase of the fault management process. The various algorithms are available for the recover the Faulty Node like FNR Algorithm.

A) Fault Detection :

The Fault Detection is the First phase of a Network Management. Fault detection schemes classified in a two types: Centralized Approach and Distributed Approach.

a. Centralized Approach:

In this Approach, Base Station Responsible for whole Network Management and Base Station have a unlimited Energy. A centralized framework called MANNA was presented in for fault management. In MANNA each Sensor node is assigned role of a manager and manager is collect the all information of every Sensor Node. Centralized approach provides good fault management while it is not suitable for large scale networks. Another drawback is that the central controller becomes a single point of data traffic concentration and hence consumes large amount of energy of the nodes. Third, this central controller becomes a single point of failure for the entire network.

b. Distributed Approach:

In Distributed Approach, big Network is divided in small Network. Each Sub-Network has a Central manager and has detected the fault in the Network.In designed a distributed fault management framework called WSND iag to identify faulty node. In the Distributed Approach, some techniques are used like, Neighbour coordination, Clustering, Node level Measurement.

B) Fault Diagnosis:

Fault diagnosis is the whole process of fault management. In a Fault Diagnosis cover only three question like where the fault is located,What type of fault it is like node failure,how does a fault occurs.The identification of root cause is the main task to repair the fault.

C) Fault Recovery:

Fault Recovery is the last Phase of the Fault Management System and in this Phase Network is reconstructed. The identify the faulty node and replace it number of technique available

Song Jia et al. proposed a recovery algorithm [12] in 2013 based on minimum distance redundant node. We propose algorithm, Recover the sensor node using the Minimum Distance Redundant node Recovery algorithm. The MDRN algorithm is Applies on the sink node with unconstrained energy consumption which knows the locations of all active nodes and redundant nodes in the WSNs. Using algorithm will have great recovery accuracy and coverage quality and also increase a lifetime if the Wireless Sensor Network.

Rajashekhar Biradar in 2013 proposed [11] an Active node based Fault Tolerance using Battery power and Interference model (AFTBI) in WSN to identify the faulty nodes using battery power model and interference model. Fault tolerance against low battery power is designed through hand-off mechanism where in the faulty node selects the neighbouring node having highest power and transfers all the services that are to be performed by the faulty node to the selected neighbouring node. Fault tolerance against interference is provided by dynamic power level adjustment mechanism by allocating the time slot to all the neighbouring nodes. If a particular node wishes to transmit the sensed data, it enters active status and transmits the packet with maximum power; otherwise it enters into sleep status having minimum power that is sufficient to receive hello messages and to maintain the connectivity.

Ting Yang et al. in 2013 proposed [3] the novel rectification algorithms (greedy negative pressure push algorithm and dynamic local stitching algorithm) is proposed to cooperatively repair broken transmitting paths in Wireless Sensor Networks. Using adjacency information, Greedy negative pressure push algorithm can efficiently grow the transmitting path to achieve the minimum energy consumption for relays model. These algorithms only stitch broken fragments of the original path.

The main challenge in wireless sensor network is to improve the fault tolerance of each node and also provide an energy efficient fast data routing service. An energy efficient node fault diagnosis and recovery for wireless sensor networks is referred as fault tolerant multipath routing scheme for energy efficient wireless sensor network (FTMRS).The FTMRS is based on multipath data routing scheme. One shortest path is use for main data routing in FTMRS technique and other two backup paths are used as alternative path for faulty network and to handle the overloaded traffic on main channel shortest path data routing ensures energy efficient data routing.

In Wireless Sensor Network all sensor nodes have the equal probability to fail and therefore the data delivery in sensor networks is inherently faulty and unpredictable. Most of the sensor network applications need reliable data delivery to sink instead of point-to-point reliability. Therefore, it is vital to provide fault tolerant techniques for distributed sensor network applications. Rehena, Z. et al. in 2013 presented [8] a robust recovery mechanism of nodes failure in a certain region of the network during data delivery. It dynamically finds new node to route data from source nodes to sink. The proposed algorithm is integrated easily in data delivery mechanisms where area failure in a certain geographical region is not considered. This

recovery mechanism is focused on multiple-sink partitioned network. It is found that it quickly selects alternative node from its 1-hop neighbour list when there are no forwarding nodes available and establishes route from source to sink.

W. Guowei et al. Proposed a Dynamical Jumping Real-time Fault-tolerant Routing Protocol (DMRF).[4] When a Sensor node fails , network congestion or void region occurs then the transmission mode will going to jumping transmission mode leading to reduced transmission delay and guarantees the data to be sent to its destination within the specified time limit. Each node can dynamically adjust the jumping probabilities to increase the ratio of successful data transmission by using feedback mechanism. This Algorithm results in reduced effect of failure nodes, congestion and void region andreduced transmission delay, reduced number of control packets and higher ratio of successful transmission. Feedback mechanism is used to enhance the successful transmission Data. The feasibility proof and performance analysis are presented to testify the superiority of DMRF.

PROPOSED SYSTEM:

The aim is to provide Energy efficient and cost effective communication in Wireless Sensor Networks. The proposed algorithm enhances the lifetime of a sensor nodes when a sensor node is shut down and it depends on Grade diffusion algorithm combined with the genetic algorithm. The algorithm can result are in the replacements of sensor nodes and more reused routing paths. This Algorithm also increases the number of active nodes, reduce the rate of data loss and reduced energy consumption.

A. **Directed Diffusion Algorithm:**

Directed Diffusion algorithm is presented by c. Intanagonwiwat in 2003. In DD algorithm is a reduced a transmission count of data and energy consumption. The DD algorithm is a Query Driven transmission protocol in whichthe sensor nodes send the data back to the sink node only when it fits the queries. The Main Disadvantages of DD algorithm is energy consumption is high and no reuse the routing path .that wise this algorithm is not popular.

B. **Grade Diffusion Algorithm:**

The Grade Diffusion (GD) algorithm is presented by H.C. Shih in 2012.The Grade Diffusion algorithm are identifies the routing path of an every sensor node and also identifies the set of neighbour node of every sensor node to reduce the transmission loading. The GD algorithm also creates a grade value, routing table, payload value, and set of neighbour node for the every sensor node. The Grade Diffusion Algorithm Updates the Routing path in Real time in the Wireless Sensor Network and the data is quickly and correctly updates.

C. **System Architecture :**

Fault Node Recovery algorithm is based on the grade Diffusion algorithm with combination of generic algorithm. The Grade Diffusion algorithms are used in FRN Algorithm for create a grade value, payload value, neighbour value and routing table of every sensor node. In the FNR algorithm is Calculate the number of non-functioning sensor nodes in wireless sensor network at the time of operation is in process, and the parameter. ***B*-th** is calculated according to Equation (1).

The GradeDiffusion Algorithm create grade Value, payload value, routing table, set of neighbour node of every Sensor Node. If ***B*-th** Value is Larger than the Zero, then FNR Algorithm is Replace by Non-Functional Sensor Node to Functional Sensor Node in the Sensor Network using a Generic Algorithm. The given Equation Find out the Bandwidth of Sensor Node.

$$B_{\text{th}} = \sum_{i=1}^{\max\{\text{Grade}\}} T_i$$

$$T_i = \begin{cases} 1, & \frac{N_i^{\text{now}}}{N_i^{\text{original}}} < \beta \\ 0, & \text{otherwise.} \end{cases} \qquad (1)$$

In (1) **Grade** is given to grade Value of Every Sensor Node.

$Ni^{original}$: is the Number of Sensor Node with grade Value i.

Ni^{now}: Number of Sensor Node still functioning at the current time with grade Value i.

The parameter β is set by the user and must have a value between 0 and 1. If the number of sensor nodes that function for each grade is less than β, Ti will become 1, and B-th will be larger than zero. Then, the algorithm will calculate the sensor nodes to replace using the genetic algorithm. The parameters are encoded in binary string and serve as the chromosomes for the GA. The elements (or bits), i.e., the genes, in the binary strings are adjusted to minimize or maximize the fitness value. The fitness function generates its fitness value, which is composed of multiple variables to be optimized by the GA. Each iteration of the GA, a predetermined number of individuals will produce fitness values associated with the chromosomes.

D. **Genetic algorithm** :

GA is a search technique used in computing to find true or approximate solutions to optimization and search problems. The Genetic algorithms are categorized as global search heuristics. The genetic algorithm (GA) is a based on the natural genetic concept. Genetic algorithm is Directed random search technique deployed in 1975.

There are 5 steps in the genetic algorithm: Initialization, Evaluation, Selection, Crossover, and Mutation. This Step is most important in our algorithm. This step isimplementing after faulty Node detected in Wireless sensor Network.

1) **Initialization:**

In the initialization step, the generic algorithm (GA) are Create the chromosomes. Every chromosome is an expected solution or result. The number of chromosomes is determined according to the population size, which is defined by the user. The gene is the main concept value of gene is the either 1 or 0. The length of Chromosome is calculated by number of non-functional sensor node.

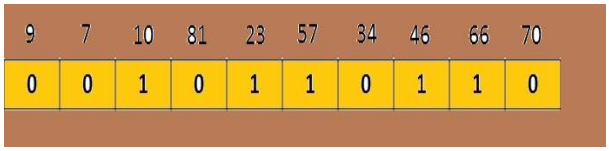

Fig 2 : Chromosome and its gene.

In Fig. length of Chromosome is 10 and gene is either 1 or 0. A 1 mean node is replaced and 0 means node are not replaced.In above fig 10 non-function node having a length is 10 an defined by 6,9,12,27,81,57,34,53,66 etc.

2) Evaluation:

The Fitness Value is calculating according to the Fitness Function. The Parameter of fitness function is chromosome and gene. The fitness function is defined over the genetic representation and measures the quality of the represented solution.

$$f_n = \sum_{i=1}^{\max(\text{Grade})} \frac{P_i \times \text{TP}^{-1}}{N_i \times \text{TN}^{-1}} \times i^{-1}.$$

Where,

Ni = number of replaced sensor nodes and their grade value at i .

Pi= number of reusable routing paths from sensor nodes with their grade value at i **T N** = total number of sensor nodes in the original WSN.

T P= totalnumber of routing paths in the original WSN.

A high fitness value is sought because the WSN is looking for the most available routing paths and the least number of replaced sensor nodes

3) Selection:

In the selection step, the select the chromosomes with the lower fitness values and it is currently not working. We use the elitism strategy and keep the half of the chromosomes with good fitness values and put them in the mating pool. Those node currently not working this node will be deleted and New chromosome is replace after the crossover step

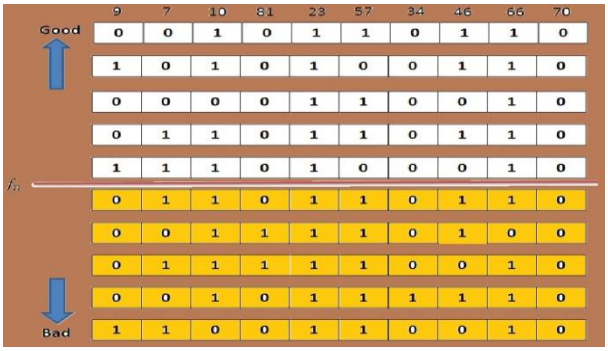

Fig 3: Selection Step

4) Crossover :

The crossover step is used in the genetic algorithm to change the individual chromosome. In this algorithm, we use the one-point crossover strategy to create new chromosomes. Two individual chromosomes are chosen from the mating pool to produce two new offspring. A crossover point is selected between the first and last genes of the parent individuals. Then, the fraction of each individual on either side of the crossover point is exchanged and concatenated. The rate of choice is made according to roulette-wheel selection and the fitness values.

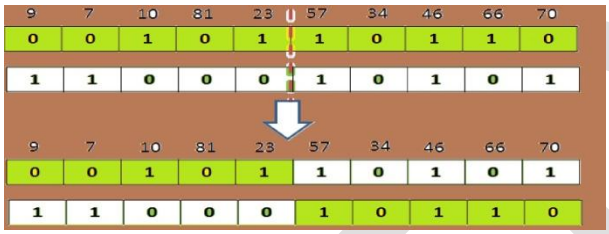

Fig 4: Crossover Step

5) Mutation:

In this algorithm, mutation step is to flip a gene randomly in the chromosome. The chromosome with the genes of 1 replaces the sensor node to extend the network lifetime.

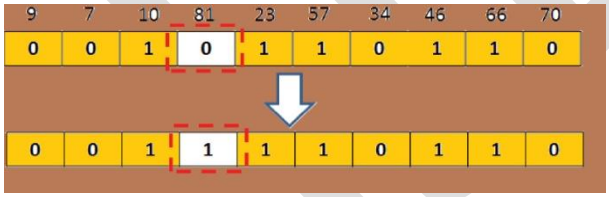

Fig 5 : Mutation Step

6) Simulation

The Project, the implement the Grade Diffusion (GD) Algorithms, Genetic algorithm (GA), and Fault Node Recovery (FNR) algorithm. The Various parameter such as a energy consumption in mJ, Power consumption in mW, Number of Active Node, Number of dead Node, time taken a node is calculated and comparisons of above the three algorithm with this parameter. Simulation of the proposed algorithm will be performed with the help of NS-2 and the simulation results will show how the faulty sensor nodes are recovered by using most reused paths and these results are compared with existing models.

CONCLUSION

The Study of a various Recovery algorithm by using number of research paper. In real wireless sensor networks, the each sensor nodes has a battery power supplies and thus have limited energy resources. The proposed algorithm enhances the lifetime of a sensor nodes when a sensor node is shut down and it depends on Grade diffusion algorithm combined with the genetic algorithm. The algorithm can result in fewer replacements of sensor nodes and more reused routing paths. This Algorithm also increases the number of active nodes, reduces the rate of data loss and reduced energy consumption.

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