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An Implementation of Fault Node Recovery Algorithm using Genetic Algorithms Wireless Sensor Network

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ABSTRACT: In this paper we are proposing the fault node recovery algorithm which enhance the lifetime of wireless sensor network .When some of the sensor node are shutdown FNR algorithm is combination of grade diffusion and genetic algorithm .This algorithm result in fewer replacement of node and more reused routing path form our simulation active nodes in proposed system are increased by 8.7times than previous system also data loss rate has been reduced by 98.8% and the most important thin i.e. energy consumption rate has been reduced by approximately 31.1%

KEYWORDS*:* Genetic algorithm, Grade diffusion algorithm, Gradient diffusion algorithm, Wireless sensor network

I. 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 depletion Fault 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.
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.

II. RELATED WORK

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. It can result in fewer replacements of sensor nodes with more reused routing paths and also increases the number of active nodes, reduce the rate of data loss with reduced energy consumption. In our algorithm study of a wireless sensor network, genetic algorithm and grade diffusion algorithm.

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 which the 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.

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Ladder Diffusion algorithm using Ant colony Optimization For Wireless Sensor Network (LD-ACO): LD-ACO For Wireless Sensor Network is Presented by H. C. Shih in 2011 to tackle the routing and energy consumption issues. These algorithms enhance the lifetime of Wireless sensor Network.

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 a every sensor node and also identifies the set of neighbour node of every sensor node to reduce the transmission loading. GD algorithm also creates a grade value, routing table, payload value, 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. Genetic Algorithm:

A genetic algorithm (or GA) is a search technique used in computing to find true or approximate solutions to optimization and search problems. The Genetic algorithm is 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 are most important in our algorithm. This step is implement after faulty Node detected in Wireless sensor Network.

Suppose we can applied the DD or the GD algorithm on the Wireless Sensor Network then the grade are create a packages and then it is broadcast in a wireless sensor network. The every Sensor node transfer the data to the destination node according to the which algorithm is applied on the wireless Sensor Network.

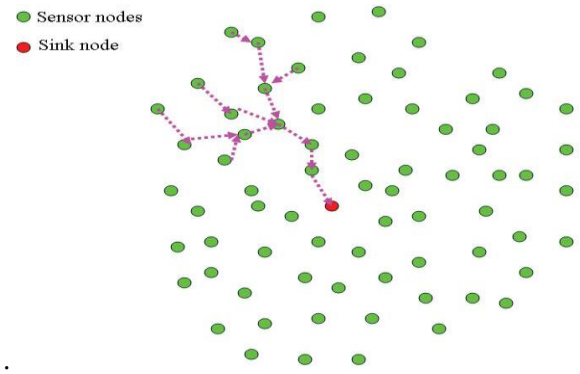

Fig1: Wireless sensor node routing.

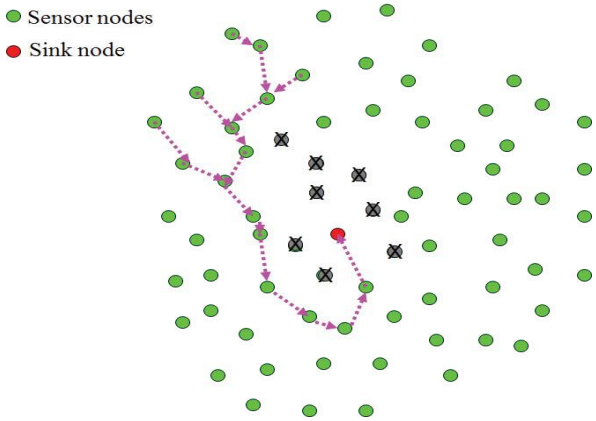

Fig 2: Wireless sensor node routing path when some nodes are not functioning.

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The WSN is Fail due to the following reason, Break in the Routing Path; Leak the Sensing Data, Depletion of Battery, Requirement More Relay Node, Wear out due to the long time. The every sensor node has capacities to transfer the live data to the destination node but transmission loading of a sensor node is high then this sensor node is fail due to the high loading data.

III. PROPOSED SYSTEM

Fault Node Recovery algorithms are based on the grade Diffusion algorithm with combination of generic algorithm. The flow chart is shown in Fig. 3.Grade Diffusion algorithm 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. Bth is calculated according to Equation (1).

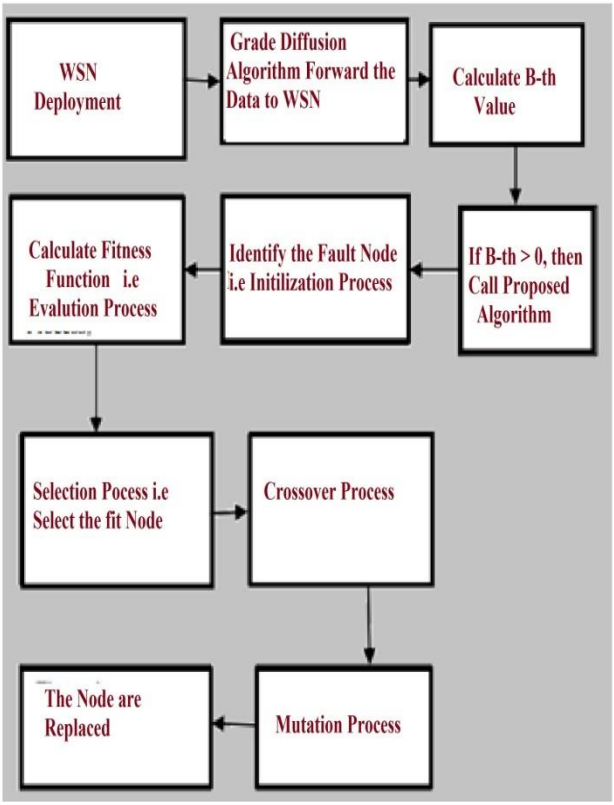

Fig 3: Block Diagram of Proposed System

In Fig 3 grade Diffusion Algorithm create grade Value, payload value, Routing table, set of neighbour node of every Sensor Node.
If Bth 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. Using the given Equation Find out the Bandwidth of Sensor Node.

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

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

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 Bth 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. At each iteration of the GA, a predetermined number of individuals will produce fitness values associated with the chromosomes

There are 5 steps in the genetic algorithm: Initialization, Evaluation, Selection, Crossover, and Mutation. Descriptions of the steps follow.

3.1 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.

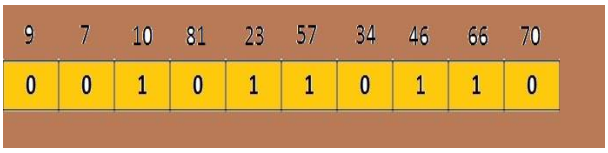

Fig 4: Chromosome and its gene.

In Fig 4 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 a defined by 6,9,12,27,81,57,34,53,66 etc.

3.2 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.

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$$f_n = \sum_{i=1}^{\max(\text{Grade})} \frac{P_i \times \text{TP}^{-1}}{N_i \times \text{TN}^{-1}} \times i^{-1}. \qquad (2)$$

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 = total number 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

3.3 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. That node currently not working this node will be deleted and new chromosome is replaced after the crossover step.

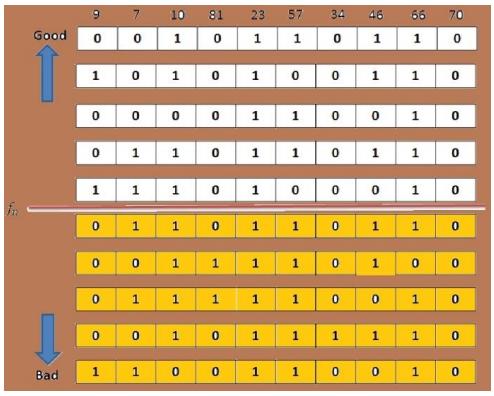

Fig 5: Selection Step

3.4 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.

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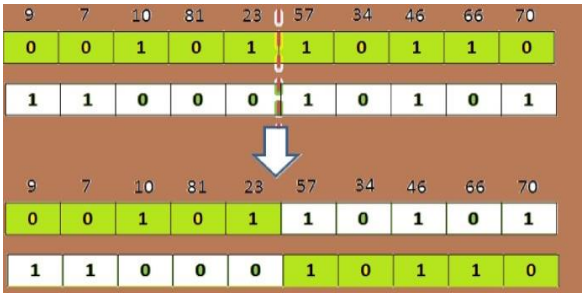

Fig 6: Crossover Step

3.5 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.

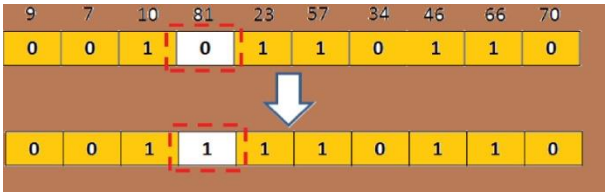

Fig 7: Mutation Step

IV. RESULT ANALYSIS

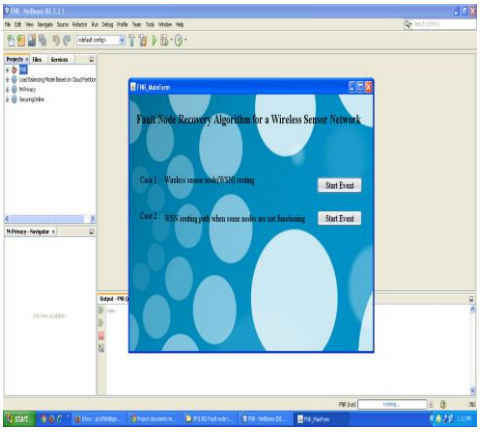

Fig 8: Home Page

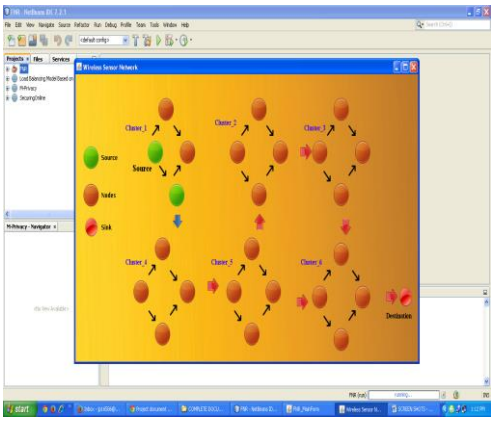

Fig 9: Sensor Node Data Sending

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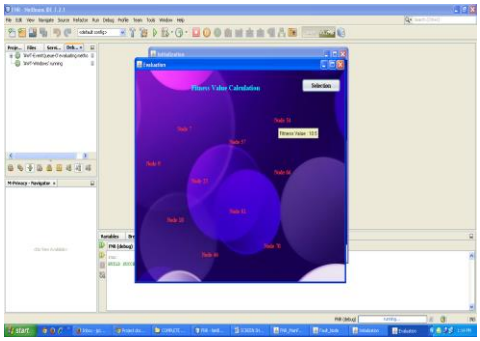

Fig 10: Bandwith Calculation

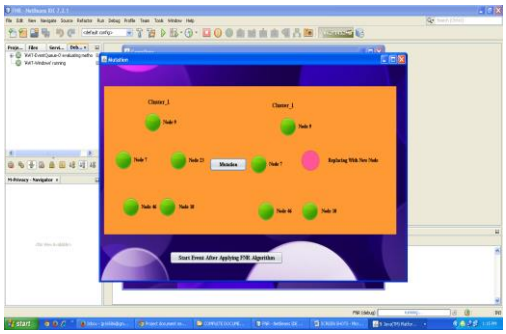

Fig 11: Node Replaced

V. CONCLUSION AND FUTURE WORK

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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