© July 2015 | IJIRT | Volume 2 Issue 2 | ISSN: 2349-6002

Improving Performance of Wireless Sensor Network for Disaster Management

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***Abstract*— Natural disaster occur suddenly. Due to occurrence of disaster, performance of wireless sensor network is degraded It is seen that communication systems are able to meet disaster management needs efficiently as long as connectivity is not interrupted. However when there is breakdown in connection pipeline of information is cut. Probability of degradation of performance of wireless sensor networks in disaster conditions is high. Most of the nodes stop working and packets are lost. Through this article we propose genetic algorithm for managing disaster. Performance metrics considered are End to End delay and Packet loss. We have implemented genetic algorithm with help of NS-2. These parameters are enhanced in order to maintain connectivity among nodes in disaster conditions.**

***Index Terms*— Genetic Algorithm, Network Simulator, disaster management, connectivity.**

I. INTRODUCTION

It is seen that communication systems are able to meet disaster management needs efficiently as long as connectivity is not interrupted. However when there is breakdown in connection pipeline of information is cut. Probability of degradation in quality of performance of wireless sensor networks in disaster conditions is high. Wireless sensor network consists of network of devices denoted as nodes. These nodes can sense environment and can also communicate this information gathered through wireless media. In disaster response quick action and efficient coordination is expected in order to reduce further risk and fatalities. In order to support disaster managers, identifying and coordinating requires tactical movements and response operations. For this purpose connectivity as quality of service should be guaranteed in order to achieve high level of disaster management. However effect of disaster is so severe that most of nodes stop functioning. While achieving high level of disaster management design factors such as node's power constrains, energy consumed, period of time and packet broadcasting should be considered. Transmission power of node is usually fixed and only varies due to environmental complexity. While designing care should be taken that node's power transmission should not vary with environment. Over consumption of energy may degrade quality of system. Disaster occur for short period of time thus simulation time should be least accordingly. Thus disaster scenario has diverse complexities. With rapid growth of complexity and scale of problem domain, creating efficient simulation for disaster management has become key requirement for research industry and management. Noisy and damaged environments and the limited power transmission, make the scenario unfeasible for a complete connectivity among nodes to support the operation. We propose bio inspired algorithm i.e. genetic algorithm to improve performance of wireless sensor network for disaster management. Parameters of wireless sensor network considered are end to end delay and number of packets loss.

II. GENETIC ALGORITHM

In order to provide solution to disaster related problems, number of algorithms have been developed. Some of them are stated as linear, dynamic, Monte Carlo, and heuristic search methods. However, results showed that a genetic algorithm provides the lowest distance solution among the mentioned optimization methods. Usually, when we want to solve a particular problem, we aim to provide solution, which will be the best among others.

Genetic algorithm (GA) belongs to set of evolutionary algorithms. Principle of genetic algorithm is evolved from natural selection and natural genetics. GA follows Charles Darwin theory of survival of the fittest principle. Since GA performs greatly in optimization, it is regarded as function optimizer. GA techniques work with a number of candidate solutions rather than one candidate solution, this feature makes it unique from traditional search algorithms. a data structure known as an individual represents each candidate solution of a problem. population is composed from group of individual. Population is also called chromosomes, these are set of solutions. GAs process usually begins with initialization of population from random guesses. GA process includes operators such as selection, Crossover, Mutation and Inversion. Genetic algorithm begins with a set of solutions (represented by chromosomes) called population. a new population is formed by taking Solutions from one population. Its stimulation brings hope that the new population will be superior than the old population. Solutions which are selected to form new solutions based on their fitness. Fitness defines efficiency of solution. If solution is the more suitable solution then has a higher chance to reproduce. However, this depends on the selector operator used. The next phase is the crossover phase where the selected individuals are mated pair by pair to form a new offspring. Finally, some of the offspring are mutated. This process is repeated till desired conditions are satisfied i.e. optimal solution is achieved. Genetic algorithm is also tested for various parameters such as the number of evolutions, selection operators, mutation rates, and priorities.

III. EXECUTION OF GENETIC ALGORITHM

Execution procedure of genetic algorithm is as illustrated in fig.1.

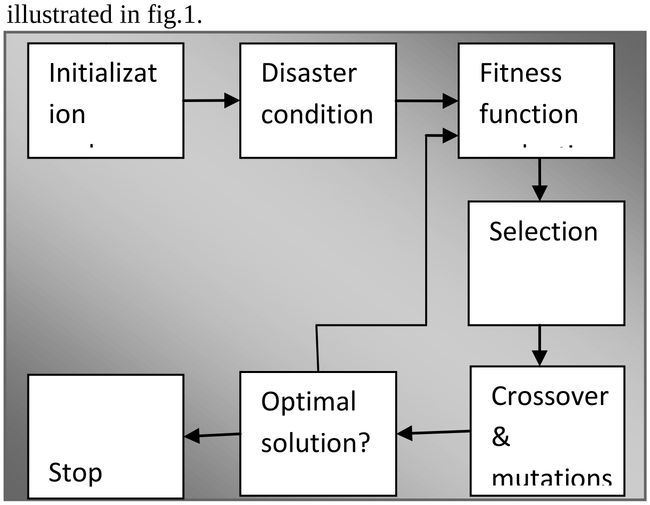

Fig.1.Genetic Algorithm Procedure.

A Initilization and chromosomes encoding

Initialization procedure involves seting up variables variables such as number of optimization , population size, maximum number of iteration minimum cost, mutation rate , selection rate, total number of bits in chromosomes and number of mutations. population size is equal to number of chromosomes. Selection rate is chosen such a way that it is fraction of population.

B Fitnsess function

Fitness function defines efficiency of solution. Initially population is choosen randomly.

$$fitness_i = \frac{1}{\sum_{j=1}^{l_i-1} C_{ge_{i(j)},\ ge_{i(j+1)},}} \quad (1)$$

Where $fitness_i$ represents the fitness value of the chromosome, l_i is the length of the chromosome, $ge_{i(j)}$ represents the gene (node) of the locus in the j chromosome, C is the link cost between nodes.

The evaluation of each chromosome serves as the measure of its reproductive fitness. a new population of candidate solutions is formed on the basis of this evaluation.

C Selection

This process is used in order to improve quality of population. Outcome of this process results in increased chances of high quality chromosomes. Increased quality results in increased probability of chromosome selection for next generation. The selection procedure also focuses the searching of promising regions in the solution space. selection schemes depends on Selection pressure . It is defined as the ratio of the probability of selection of the best chromosome in the population to that of an average chromosome. Solution space is sorted in two regions i.e. one with high fitness values and other with less fitness values and candidate having high fitness values are selected.

D Crossover

In this process mating is pefromed using single point crossover. Crossover is responsible for producing new offspring. two strings are selected and portion of their structures are exchanged . The new offspring generated replace the weaker individuals in the population.

E Mutation

Mutation is a local operator which is applied with a very low probability of occurrence. Mutation is used to make changes in the bits while performing crossover. Its function is to alter the value of a random position in a string.

F **Stopping criterion**

This is decision block. If desired solution is achieved then process is stopped, if desired solution is not achieved then again genetic process is applied till the desired solution is achieved.

IV. IMPLEMENTATION

A simulation structure based on NS-2 and a GA is implemented. The network simulator NS-2 is an object-oriented simulator. It is developed as a part of the VINT project at the University of California in Berkeley[1]. It is extensively used by researchers and academics in order to simulate both wired and wireless networks. We have used NS-2 to evaluate the GA fitness function.

A file named .tcl defines simulation parameters. Programming is done in tcl . disaster.tcl uses OTcl as the programming language. Parameters defined in .tcl files are End to End delay and Number of packet loss. The main features are described in the .tcl file. These features are the mobility of nodes and the traffic pattern among nodes. The characteristics of each simulation area of the disaster area script namely Disaste.tcl.

The traffic patterns have been defined by using the constant bit rate (CBR) generator with help of NS-2 package.traffic generator two types of CBR communication flows can be defined: inter-communications and intra-communications. In intra-communications, the traffic flows are defined between two nodes located in the same area, for instance two nodes located in region where disaster has occurred. inter-communication flows two nodes located in separated areas. The output of CBRgen Disaster is a .tcl file, namely out.tr, which is also integrated into the disaster.tcl. integration of traffic and mobility patters in disaster.tcl can be done with help of c program. the simulation in NS-2 can be carried out after both mobility and traffic patterns have been generated. The master program consists of a loop whose iterations correspond to the evaluations of the population taken into account by the GA. At each iteration, the previous framework runs Nt different simulations using NS-2, where Nt is the number of chromosomes in a population.

NS2 is made of two parts basically such as NS means network simulator and other part is NAM. NAM means network animator. NS is used to simulate all the protocols over the wireless as well as wired networks. On the other hand, the network animator tool is used to visualize the simulation of the networks in the form of actual communication patterns.

NS2 is open source and free software tool which is widely available for downloads from the Internet. It was initially developed for the UNIX systems but later by using the environment of the Cygwin under the Windows XP we can run the ns2.

We have carried out experiments using different number of sink nodes i.e for 2,4,6,8 and 10. Transmission protocol is UDP While MAC protocol is 802.11. Routing protocols used are DSR. Disaster affected DSR (DDSR), disaster monitoring DSR (DMDSR). Number of Sensor Nodes are 220. Network Size is 1000 X 1000. Mobility Speed is 2 m/s . Simulation Time is 100 s . Transmission Packet Rate Time is 10 m/s and
Pause Time is 1.0 S.

V. SIMULATION RESULTS

In this section we present demonstration results. For demonstration we have used network simulator NS-2. First parameters of wireless sensor network in disaster conditions are measured, then parameters after applying genetic algorithm are measured and finally results are compared. graph is as shown below.

A. End-to-end delay

This includes all possible delays caused These delay are usually caused by buffering during route discovery latency. It may also be caused due to queuing at the interface queue. Other factor which contribute for increased delay are retransmission delays at the MAC, propagation and transfer times. Average end to end delay is as enhanced as shown in fig.2.

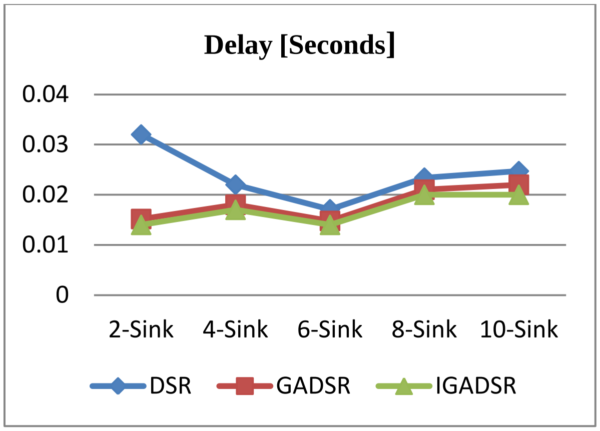

Fig.2. average delay

B. Number of packets dropped

This is measure of number of packet loss. With help of genetic algorithm number of packet loss is minimized as seen in fig.3.

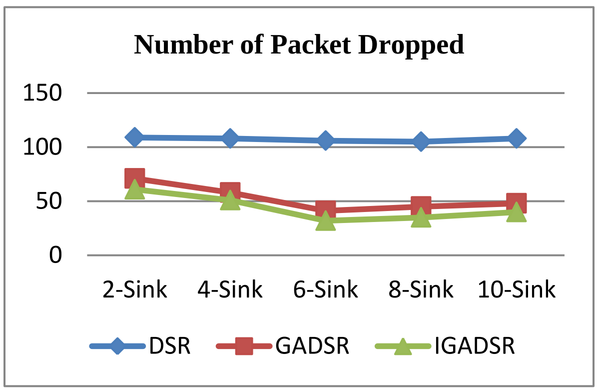

Fig.3.number of packets dropped

VI. CONCLUSIONS

In this article we have presented an performance improvement technique of wireless sensor network using genetic algorithm . It helps to maintain connectivity among nodes in disaster scenario. We have proposed bio inspired algorithm i.e. Genetic algorithm for disaster Management It is seen that after applying genetic algorithm performance of wireless sensor network in disaster is enhanced.

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