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An Improved Genetic Algorithm based Fault tolerance Method for distributed wireless sensor networks.

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Abstract: The Combination of Genetic Algorithm (GA) with Distributed Sensor Networks (DSNs) has radically brought new networking paradigms and new applications. These Distributed Sensor networks can communicate to achieve higher levels of co-ordinate behavior. However these networks often suffer from various failures since they are deployed in critical environments. The main objective is to organize such a network which consumes less energy and fault tolerant using Genetic Algorithms. In this paper, we get the dynamic outcomes of implementation of Genetic Algorithm on such networks. The comparative study of Simple GA used in existing system is done with GA implemented in current system. This paper aims to show various graphical representations after comparison.

Key Words: Genetic Algorithm (GA), DSNs, Comparative Study.

Introduction

The emergence of wireless, compact, light-weight Sensors in technology is in-turn promoting the miniaturization trend which is on-going. DSNs are such networks which are deployed in hostile environment where human intervention is profusely impractical. A considerable amount of attention and research has been devoted in recent years to the deployment of Distributed Sensor Networks (DSN) for example space exploration, battle field surveillance, search and research, costal and border protection, today such networks are used in many industrial and consumer applications and environmental conditions monitoring and so on. Energy efficiency, network or topology control and fault tolerance are the most important issues in the development of next-generation DSNs. A DSN is a high level distributed set of sensors that are interconnected by a communication network in the environment. The sensors in the network have the unique feature of self configuring among themselves in unattended areas and have the ability to communicate with each other. DSNs may suffer from certain possible conditions as follows:

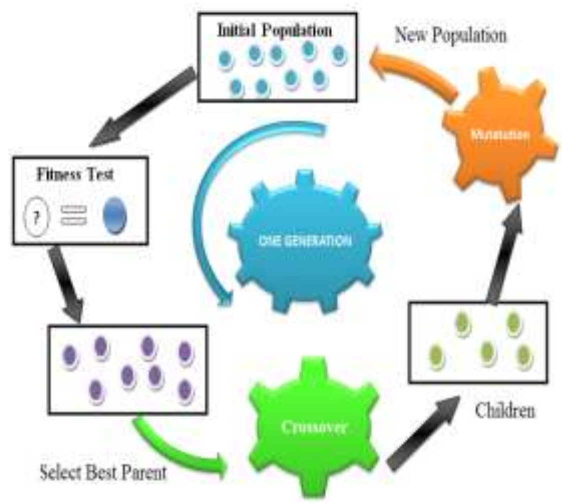
- Malicious activity, or by extended use.
- Extensive operation may drain some of the node power.
- Hazards may change devices positions over time.

This may need to deploy additional sensors to fix the network. Instead the Genetic Algorithm is applied in order to solve these conditions. The current working is all about Distributed sensor Networks (DSN) framed with Genetic Algorithm (GA).

The Genetic Algorithm is meta-heuristic inspired algorithm belonging to large class of evolutionary algorithm. The father of GA was John Holland invented in 1970. He represented intelligent exploitation of random search. GAs are used to generate high quality solution to optimization and search problems. Genetic Algorithms were invented to mimic some of processes observed in natural evolution. GA simulates “survival of fittest” among individuals over consecutive generation for solving problems. This principle was given by Charles Darwin. He stated that fittest individual dominates over weaker ones. Individuals in population are made to go through a process of evolution. Each individual is coded as finite length vector of components or variables, in terms of some alphabet, usually {0, 1}. GA aims to use selective breeding of solutions to produce offsprings better than parents by combining information from chromosomes. Thus GAs will find better solutions in reasonable amount of time and applied for bigger problems (NP Hard problems) such as optimization.

Existing System

In the existing system, the Wireless Sensor Network was deployed and Simple Genetic Algorithm was implemented for the overall network performance. The simulation model was showing the comparison of other traditional algorithms such as LEACH (Low Energy Adaptive Clustering Hierarchy) and GA. The performance graph was the result of the simulation. It concluded that how GA proved to be the best than any other traditional algorithms for example we have taken LEACH. We have calibrated the performance of our approach by proving that GA quickly converges to the optimal solution. For large networks, the GA generates solutions that significantly extend the lifetime of the network, compared to the conventional routing strategies. The Figure shows existing GA:



<u>Fig.: Simple GA in Existing System</u>.

Proposed Work

Population Generation Or Node Deployment: This is the first module in which nodes are deployed in metaheuristic way. The sensor nodes will take their position in the simulation graph.

Dijkastra’s Algorithm: After the node deployment phase, there is need to find out the shortest path from the source to destination. Thus the easiest algorithm is applied known as Dijkstra’s shortest path routing algorithm. It calculates the distance of neighboring nodes and tracks the possible solutions or ways to reach the destination. The routing tables are maintained while implementing the Dijkstra's Algorithm. As we know the DSNs have the ability to communicate and establish the link among the nodes.

Genetic Algorithm Implementation: Stating the Fitness Function is a crucial stein GA. It performs the fitness test on the population to find out best fittest individual. The proposed fitness formula is applied on the individual sensor node and not for the overall network. This will increase the fault tolerance of the network. The parameters in the fitness function are energy of each node and the strength of link established in the network. Two more parameters to be considered are path and obstacle. Path is the variable which shows that whether the path exists up to destination or not. The obstacle is also like flag which states that route is free from obstacle or not. One important thing to be taken care is that the value of any of these factors must not be negative. Thus it is clear that if any obstacle occurs the flag is set to -1 if not then 1. Similarly if path exists then 1 otherwise -1.

Fitness Function:

$$\mathbf{(Chromosome)} = \sum^{8} \mathbf{E} * \sum^{8} \mathbf{L} * \mathbf{P} * \mathbf{O}$$

Where,

E= Energy in joules,

L= Strength of Link

P= Path

O= Obstacle

The fitness value of the chromosome must be positive.

We can compute the value of Energy(E) by

$$\mathbf{E = Ei * D}$$

Where, Ei is the energy consumed per packet transfer and D is the distance.

$$\mathbf{L = C/E,}$$

Where,

C is channel capacity and E is the Energy of Chromosomes in Joules.

PARAMETERS	EXISTING GA	PROPOSED GA
1. Fitness Formula:	$F = \sum_i (w_i \times f_i), \forall f_i \in \{C,$	**(Chromosome)=$\sum^{8}$ E * $\sum^{8}$ L * P * O**
2. Selection Type	Random	Roulette-Wheel
3. Cross-over Type	One-point	One-point
4. CrossOver-Rate	0.002	0.9
5. Cost Of Termination	High	Medium
6. Energy Consumption	Reduced as compared to other optimization techniques	Reduced as compared to other algorithm
7. No. of Live nodes in network	Less	More as compared to existing system

Experimental Results:

Comparison of Existing GA with Proposed GA

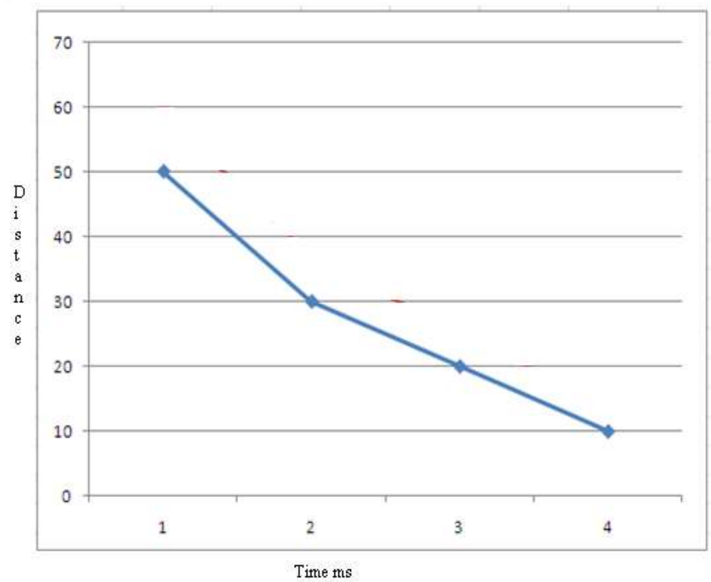


Figure: Graph1 shows distance versus time

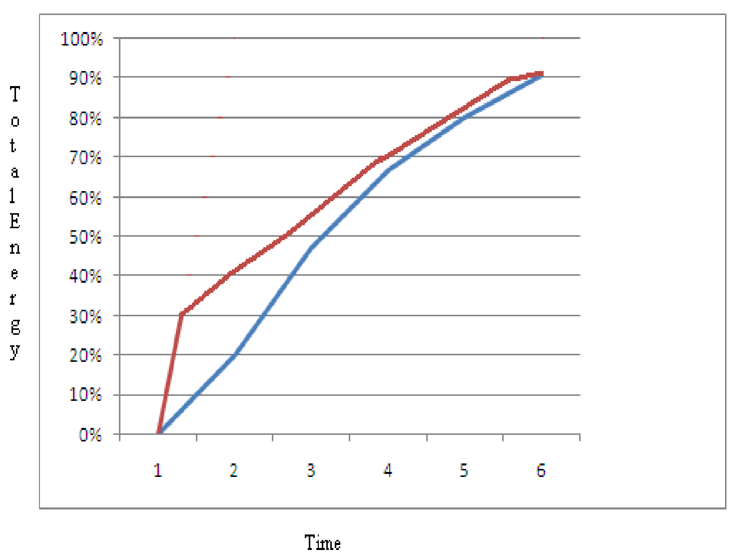


Figure: Total Energy Consumption of nodes Versus Time

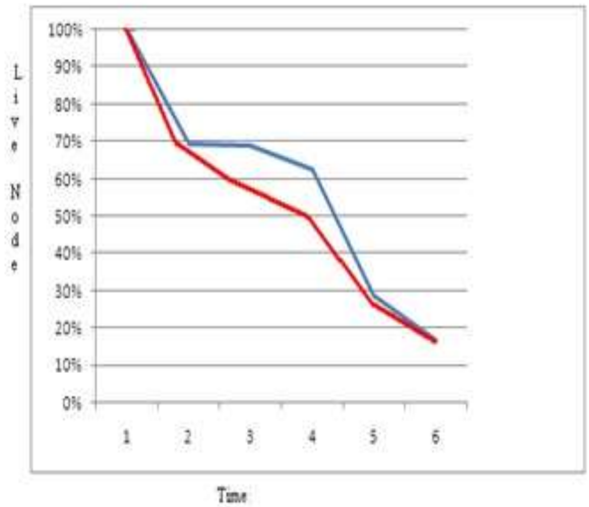


Figure: Graph3 showing percentage of live nodes decreases

Conclusion:

The implementation of Genetic Algorithm has really proved to be the best option as it has got many advantages such as its robustness, its self repair quality and fast calculation of optimal solution in the large search space. Proposed method has been compared with existing GA technique. It has been found that in Graph 1 distance increases as time passes. It is found in this comparison that energy consumption is reduced by 2% to 20% as compared to existing one. The lifetime of network also sustains as shown in graph 2. The number of live nodes or best nodes in the network is found to be more than compared with the existing system.

References:

[1] D. E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning, Addison Wesley, Reading, MA, 1989.