A Survey on Energy Conservation in Wireless Sensor Network with Genetic Algorithm

Harpreet Kaur, Dr.Rohit Bajaj

Abstract— **Energy conservation refers to using less energy in the particular process i.e operational service. In WSN energy conservation plays vital role as computation depends upon this. A proper energy efficiency allows less nodes to get dead and increase network lifetime. The most essential factor that influence the sensor's energy consumption ,the number of operations to perform data gathering and data transmission. The network must be alive until the whole computation get completed. So to ensure this various routing protocols and algorithms are implemented like Clustering Algorithm based on cell combination(CACC), Energy Efficient Clustering Virtual Area Partition(VAP-E),Power Efficient Zoning Clustering Algortihm(PEZCA) ,Power Efficient Gathering in Sensor information System(PEGASIS),Energy Efficient Clustering Schemes(EECS),PSO-Clustering, LEACH and its descendant but still there are chances that we can get more better results. That leads to. Genetic Algorithms to overcome the problems of energy consumption and the improved the lifetime of network. Genetic Algorithm is for optimized problems using random search .It is based on biological concepts that takes place in human body.**

Index Terms— **Clustering, Cluster Head, Energy consumption, Genetic Algorithm, Sensor node, WSN**

I. INTRODUCTION

Wireless sensor network hardly a technology not known by anyone today. Wireless sensor network are widely accepted in areas like computer science and telecommunications.WSN has designed to monitor physical and environmental conditions. It becomes widely adapted as ease of implementation, cost, reliability and security.

WSN interconnected network of sensor nodes may be homogeneous or having specific property .Sensor nodes have capability of performing computation, communication and sensing. With each sensor node batteries are connected. Base station battery are provided with more computational power than other sensor nodes. Its aim is to collect ,process and store data from various individual sensor nodes. Since these batteries are not replaceable and chargeable. Researchers try to innovate a technique to make it possible to charge them. Sensor nodes are distributed in any environment may be physical world, Information technology infrastructure and biological system. The size of sensor nodes may be vary and the cost associated with it depends upon the complexity of individual sensor node. In sensor network four basic components are (1) an assembly of distributed or localized sensors (2) an interconnecting network (3) a central point of information clustering; and (4) a set of computing resources at the central point to handle data correlation, event trending, status querying, and data mining [1].As sensor nodes handle potentially large quantity of data so algorithmic methods plays an important role for data management in network. In WSN energy dissemination takes place during data transmission and data receiving by all the nodes. So we need energy efficient method that can help to increase the lifetime of network.

In WSN power efficiency can be achieved by these methods[2]

1.Low-duty-cycle operation.

2.Local/in-network processing to reduce data volume

3.Multihop routing reduces the signal path loss due to long range transmission . Every node in a network act as repeater therefore reduces the link range transmission and also power consumption during computation.

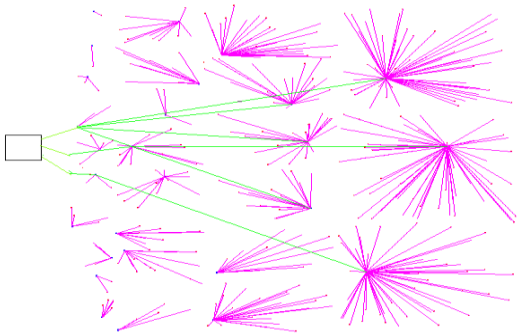

Figure 1. Multihop Routing of 400 nodes in WSN

II. RESEARCH CHALLENGES IN ENERGY CONSERVATION WITH WSN

The most important problem facing by the researchers in WSN to how increase the lifetime of batteries associated with sensor nodes. The lifetime should be such that as the entire computation in the network takes place. Sensor nodes are provided with batteries but due to energy consumption in the network they lost their power. As more energy dissipation takes place during transmission of data as compare to reception of data. Researchers argument that energy consumption could be reduced by considering the existing interdependencies between individual layers in the network protocol stack.

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First Author name*, Computer Science Department, Chandigarh Engineering College, Chandigarh, India, +918054166763*

Second Author name*, Computer Science Department, Chandigarh Engineering College, Chandigarh, India,+918699237775.,*

In WSN thousands of sensor nodes are involved and the transmission of data from one to node another and finally to sink become very complicated .In the concept of single hop routing more power consumption has been taking place.
The phenomenon of clustering are widely adopted in research for large scale WSN area as it afford more scalability ,ensure energy efficiency and promised longer lifetime of network. CH constitute of two level hierarchal structure where CH represent higher level and all others nodes represent lower level. In every round nodes in all clusters send their data to associated CH.CH then transmit data to sink either by a direct link or by sending data to other CH and finally to sink known as multi hop routing. Multi hop routing has become more advantageous rather than single routing with more power consumption.

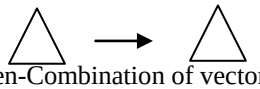
III. GENETIC ALGORITHM

Genetic algorithms are dominant search technique belongs to evolutionary algorithm class that are used effectively to solve problems in different aspects of areas. GAs can be implemented straightforward and provide significant gains in performance. Genetic Algorithms are direct, parallel, stochastic method for global search and optimization of problems.
A GA initiated with a set of randomly generated possible solutions for a task called a population. Included individual solution in the population recognized as chromosomes. Every chromosome may possibly be represented as a simple string or an array of genes enclosed with part of solution.A Genetic Algorithm take into account fitness to test on new structures to choose the best population..A fitness function provided the fitness value to each individual.[3] The fortune of an individual chromosome relies on the fitness value.
Working of GA
Précis of how the genetic algorithm works

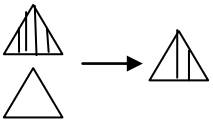
1. First, at random population created known as initial population
2. The algorithm creates the series of next generations by considering the individual population in current scenario. Following steps are consider
   a. Assign scores to each member in the current population
   b. Convert these score into more useful range of values
   c. Based on the fitness select members as parents
   d. Reproduction takes place. Mutation-children produce from single parent by making small changes in it. Crossover-vector pairs of both parents are connected
   e. Children of the current scenario used to form next generation

Procedure stops when any condition of the stopping criteria is met.

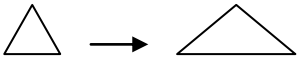
Initial Population
Set of chromosomes are present from which two pairs must be get selected for mutation for further generation.
Fitness
Fitness refers to ability of an individual to pass on its genetic material. This behavior allow them to survive and further more reproduction. Function defines the problem help in evaluation of fitness. Individual ability to survive depends on this fitness value ,higher the value higher chances of survive.
Selection
Individuals are selected on the basis of fitness function that mate to produce new chromosome.
The most popular selection methods are Tournament selection and Roulette wheel selection. In Tournament randomly individuals are selected and tournaments are played among them and the best one choose for the crossover. Roulette wheel selection involves all the chromosomes to be placed on the roulette wheel in respect to their fitness value. As on the wheel all the individuals associated with particular segment, larger the segment larger the fitness value.[4]
In GA three types of children concerned: Elite children-Individuals having the high fitness value enable them to survive long.



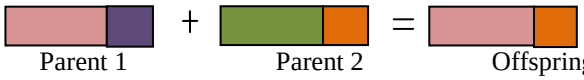
Crossover children-Combination of vector pair of parents.



Mutation children-By doing changes in the single parent



Coventional Crossover
In crossover two participating individuals are involved in mating, both recombine their genes resulted in new chromosome. Default crossover assured the average weight age of parents involved. Crossover may be at single point known as single crossover or crossover may be at multiple points known as multiple crossover. Recombination includes the special bit called mask.
Mathematical representation
C1=Mask1 & P1 +Mask2 & P2
C2=Mask2 & P1 + Mask1 & P1



Single Crossover

Multiple Crossover

Mutation
In mutation random changes in the genes of single parents take place.But it could not guarantee that the features are satisfied according to need. Selection process has responsibility to ensure that mutated individual has high fitness in comparison to general population, unless chromosome extinct to mate again in nearby future. 0.5 to 1 % usage rate.

2 3 2 5 4 6 9 1 3
2 3 2 5 4 4 9 1 3
Mutation in Chromosome

FitnessParameters
Presented parameters help in increase the network lifetime and provide a way to less energy consumption.
1. **Node distance**- The distance between the nodes and their respective CH. The distance between them

$d=\sqrt{(xch-xn)^2+(ych-yn)^2}$

where CH*(xch,ych)* and nodes*(xn,yn)* are coordinates of CH and their associated nodes. Larger the value of d more energy will be consumed as we need to keep the value of d as smaller as possible.

2. **Routing Distance to sink**- The distance between the CH and sink. Coordinate of sink(xsink,ysink) and CH(xch,ych). The distance between them

$dr=\sqrt{(xsink-xch)^2+(ysink-ych)^2}$

Similarly as in node distance, larger the distance more energy consumption will be present.

3. **Average Ch's distance**- As all CHs pass data to one another to transmit data to sink known as multi hop routing. By taking into account radio model shortest will be selected each time.

$Dch=\sqrt{\frac{(xa-xb)^2+(ya-yb)^2}{n(n-1)/2}}$

where (xa,ya) and (xb,yb) coordinates of two neighbor CH and n(n-1)/2 edges of complete graph

4.**Energy Consumption**-

$E=Et(i,ch)+n*Er+(n-1)*Eda+Et(ch,sink)$

where E denotes the energy consumption in network, n denote s total number of nodes in cluster, Et(i,ch) denote energy transmission in nodes while sending data to CH, Er denotes receiving energy in CH, Eda denote energy loss in data aggregation, Et(ch,bs) denote energy transmission in CH while sending data to sink.

5. **Number of rounds**- Suppose R represents number of rounds need to be performed to complete to computation. R rely on the current status of energy of all the nodes in network. The larger the value of R means the current generation has better fitness value.

6. **Number of transmission**- Depends upon the current condition of the energy level of the network.

IV. LITERATURE SURVEY

J.Inakagi .et.al [5] include the comparison between Dijkastra algorithm and their proposed genetic algorithm that provide many solutions to a search and capable to find both shortest route and many semi shortest route instead of only one path. Chang Wook Ahm and Ramakrishna[6] proposed genetic algorithm approach to be used in shortest path routing. They have created a Population sizing equation that enable us to get the preferred solution.

R.Khanna et.al [7] introduce a method with which cluster head is choosen so that the distance between the CH and its all nodes in the cluster should be minimum, helps in energy conservation.

O.Islam et.al [8] proposed a way in which GA form energy efficient clusters for routing in WSN.They include fitness parameters like direct distance to sink, cluster distance, transfer energy and number of transmissions.

Azadeh Pourkabirian and Abolfazl Toroghi Haghighat [9] proposed energy aware QoS routing protocol for WSN by using genetic algorithm concept. Aim to increase the lifetime of the network i.e. time at which first node get dead losing its all energy.

J.Zang et.al[10] proposed a novel clustering algorithm that select the CH having sufficient amount of energy helps in improving the rate of data aggregation in the network.

H.Seo et.al[11] takes into account the distance of data transmission between the CH and its corresponding nodes as fitness function. Energy consumption depends upon the battery status of nodes and the way in which CH get selected.

R.Nallusamy et.al[12] find out the applications related to environment, military and to monitor patients in the hospital. Their approach include genetic algorithm for shortest path routing in wireless ad hoc sensor network.

G.Hossein EkbataniFard et.al[13] proposed QoS routing protocols. Clustering technique involves one CH among all the clusters and others nodes rely on them, further these CH send data to sink. QoS of the network depends on these non-CH nodes.

A.Zahmatkesh and M.H Yaghmaee[14] approach a multi-objective algorithm to generate an optimal number of CH snd their associated nodes that minimize the cost of transmission.

Yin Wu and Wenbo Lui [15] proposed an algorithm energy harvesting genetic based unequal clustering- optimal adaptive performance routing algorithm that comprise of two parts(i) energy harvesting genetic based unequal clustering algorithm (ii) optimal adaptive performance routing algorithm

N.Thangadurai et.al[16] proposed a new GA model to minimize the energy consumption and provide far better energy efficiency as compared to other existing Gas technique.

In all these studies they used GA in different ways by considering their own parameters for better energy efficiency as it is the current problem facing in WSN. Aim to increase the life time of network as it directly depends upon the energy consumption of nodes if there is less energy consumption then for more time all the nodes will be live and more computation will get performed and the overall lifetime of network will be increased. As it is the current problem in WSN

V. CONCLUSION

Energy consumption, the most essential factor that influence the performance of the network. The network reliability, adaptability depends upon the sensor lifetime. It can be done through Genetic Algorithm. Genetic algorithm consider as heuristic search function that find out the solutions of optimized problems. Genetic algorithm has faster computation speed that makes it popular among researchers to use .Multi objective optimization become possible ,accuracy of parameters it provided, capability of solving complex design, ability to provide better solution and solve out complex design makes it possible for genetic algorithm to gain special place in WSN. Many problems like energy efficiency, convergence time ,find shortest path for routing, cost of reduction in data transmission ,increase lifetime of

network and can evaluate the fitness of the network researchers able to find the solution by this heuristic search function. Researchers trying to combine the genetic algorithm with other algorithm in the hope to find out the better solution to our problems in WSN than the existing one.

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