A Review Paper on Energy Consumption and Reliability of WSN using Genetic Algorithm and MR-PSO

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ABSTRACT
Wireless sensor network are produced without using a fixed network infrastructure with the help of small sensor nodes communicating over wireless links. Wireless sensor network (WSN) is a group of three kinds of nodes: sensor node, and sink node, etc .Energy sources and communication is performed via wireless medium and every node has a limited processing capability. In this paper, Genetic Algorithm (GA) and MR- PSO is proposed to optimize sensor nodes' energy consumption. The most important is the clustering technique as an efficient way for reducing consumption of energy of a sensor node as well as the transmission cost. Multi-objective algorithm is also used which makes an optimal number of sensor-clusters with cluster-heads and reduces the transmission cost. The components are also used and the average fitness of the system is evaluated.

Keywords
Wireless Sensor Networks, clustering, cluster-head, energy consumption, Genetic algorithm (GA), MR-PSO

1. INTRODUCTION
The wireless sensor network consists of various sensor nodes spread in an environment to gather information about the environment.[4]

WSN is formed by numerous sensor nodes that form the backbone of the network. These sensor nodes can be divided into many groups like sensing nodes, sensor or forwarding nodes and gateway or sink nodes. In WSN, sensing nodes are the main act and these nodes are programmed to sense the intended parameter, insert the information into packets and thus to be sent out. Then, forwarding nodes are used to forward the packets to the target. The gateway or sink nodes are connected to base station with (USB) connection or with wireless connection. These gateway nodes are used as intermediate between base station and the network. [1]

The applications are divided into several sub applications like military, medical, and commercial applications. Among military applications are communication, command, and intelligence defense networks. [2]

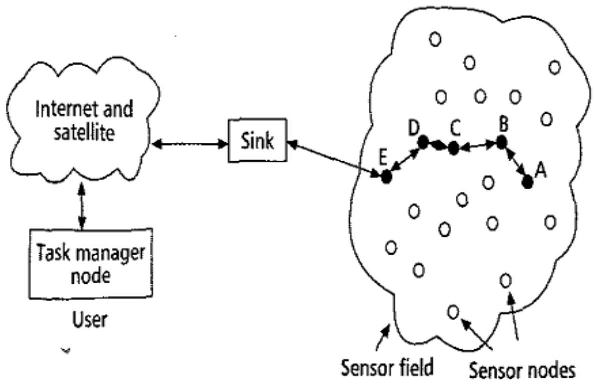

Fig 1. Sensor Nodes Scattered in a Sensor Field [1]

Recent WSN have now led to searching for new routing schemes for wireless sensors where energy awareness is very vital. The aim of networks is to attain high quality of service (QoS) communication. Ad hoc routing techniques proposed in the literature do not fit the necessities of the sensor networks. Hence, special multihop wireless routing technique between the sensor nodes and the sink node with a focus on energy efficiency is vital to be designed. A fixed number of cluster heads are selected on the basis of maximum residual energy of the nodes, a clustering method is proposed. Each cluster head is associated with a group of nodes on the basis of minimum distance among them. In such scheduling, all the nodes subsequently remain alive for long time and dissipate uniform energy. [9]

The rest of the paper is prepared as follows: In section 2, we analysis the related works in this field. In Section 3, description of energy model is there, that could be used by the sensors. Finally, in section 4 conclusions are there.

CH Selection is based on following

a. **Residual Energy:** After every round the remaining energy of every node.
b. **Initial Energy:** Initial energy in all sensor nodes.
c. **Energy Consumption Rate:** The energy degenerate in sensing information, sending information to base and energy associated with cluster arrangements.

2. REVIEW OF CLUSTERING ALGORITHMS FOR WIRELESS SENSOR NETWORK

2.1 Genetic Algorithm
Generic algorithm estimates an optimal solution and generates different individuals. Focused fitness function is also procedure

of the algorithm. Following are the section which describes the Fundamental parts of a generic algorithm.[2]

2.1.1 Initialization

The genetic algorithm come with a basic population comprised of chromosomes which includes genes with series of 0 s or 1 s. afterward. The algorithm leads individuals to achieve an optimum solution by the mode of repetitive processes including crossover and selection operators. A new population is developed by two ways: steady-state GA and generational GA. In former, one or two members in the population are replaced and at the same time, the generational GA also replaces all the generated individuals of a generation. [2]

2.1.2 Fitness Calculation

The fitness function is designed to increase the network lifetime, which evaluates whether, a particular chromosome increases network lifetime or not. The algorithm conserve the historically obtained most excellent chromosome, that is, with the highest fitness value, called elitism. The fitness of each chromosome is calculated by

$$f(C) = \sum_{i=1}^{N-1} di^2$$

where di denotes the distance between the (i+1)the node (or, gene) and the ith node denotes the data gathering chain. A higher value of the chromosome energy indicates a longer data gathering chain and which means to be an inferior solution.[9]

2.1.3 Selection

The selection process determines which of the CHs chromosomes from all the current population will mate to make new chromosomes. Hence these new chromosomes join the existing population. The next selection will be based on this combined population. Roulette wheel selection is used in the proposed algorithm. It helps to determine the selection probability for each CHs chromosome in proportion with the fitness value (1/F(X)). The CHs chromosomes which are having higher fitness values are more likely to be selected as the chromosomes of population in the next generation.[5]

2.1.4 Crossover

The crossover and mutation types are of major importance to the performance of the GA optimization. Multiple cross-over points produce new generation from the selected parents. With some specific probabilities, crossover is also applied. These probabilities are tuned after proper experimentations.

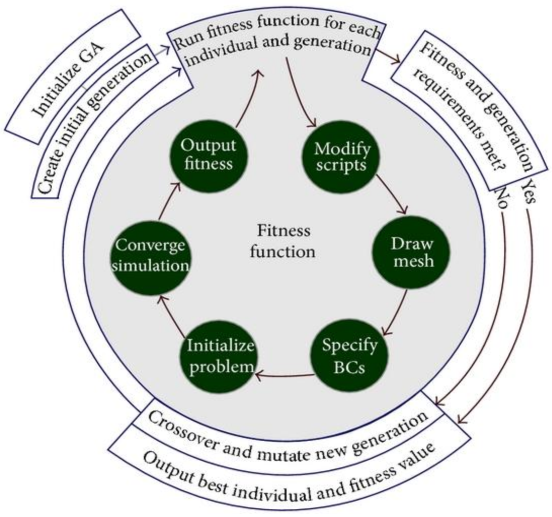

Fig 2. General Scheme of GA Mechanism

2.1.5 Mutation

The mutation is an exploration process which transforms genes to overcome the limitation of the crossover.

In this paper, this operation enables the search for optimal chromosome by transforming a cluster-head to a cluster member and a cluster member and a cluster-head, with a small probability. The probability of transforming from cluster member to cluster-head is set higher than that of the opposite case for preventing abnormal increase of cluster-heads., clusters should be reconstituted after executing the crossover and mutation, since the cluster-heads' positions could have been shifted. [3]

2.2 Fitness Parameters

The fitness of a chromosome is designed to increase the network life time and to decrease the energy consumption. Some of fitness parameters are described in this section.

1) Direct Distance (DD) to Base Station: It is the sum of all distances from sensor nodes to the BS. This distance is defined as follows:

$$DD = \sum_{i=1}^{m} d_{is} \quad (4)$$

Where dis is the distance between node i and BS node s. For a longer network, this distance should be minimized; otherwise, the energy will be wasted of most of the nodes .However, for a smaller network, direct transfer to BS is to be fine.

2) Cluster Distance (C): The cluster distance, C can be defined as the sum of the distances from the nodes to the cluster head and the distance between head and BS. For a cluster having k member nodes, the cluster distance C is defined as follows:

$$C = \sum_{i=1}^{k} d_{ih} + d_{hs} \quad (5)$$

Where dih is the distance between nodes i and cluster head h and dhs is the distance between cluster head h and BS node s. For a cluster having large number of widely-spaced nodes, the cluster distance is high and thus the energy consumption will also be higher. C should not be too large for reducing energy consumption. Size of the clusters will be controlled by this metric.

3) Cluster Distance - Standard Deviation (SD): The variation in the cluster distances should not be large for uniform spatial distribution of sensor nodes, where nodes are uniformly placed. However, for non-uniform spatial distribution, the cluster distances must not be necessarily the same where nodes are randomly placed. According to the deployment information the variation in cluster distances should be tuned. Variation in cluster distances will show poor network configuration if the deployment is uniform and must be tuned to get uniform clusters. The cluster distances, SD, with a deviation μ can be considered as follows:

$$\mu = \frac{\sum_{i=1}^{h} d_{cluster_i}}{h} \quad (6)$$

$$SD = \sqrt{\sum_{i=1}^{h} (\mu - d_{cluster_i})^2} \quad (7)$$

4) Transfer Energy (E): It is the energy consumed to transmit the aggregated message from the cluster to the BS. The cluster having k member nodes, cluster transfer energy is as follows:

$$E = \sum_{j=1}^{k} E_{T_{jh}} + k * E_R + E_{T_{hs}} \quad (8)$$

In Equation 8, the first term shows the consumption of energy to transmit data from k element nodes to the cluster head. The second term represents the energy consumed by the cluster head to receive k messages from the element nodes. Finally, the third term shows the energy required to transmit from the cluster head to the BS.

5) Number of Transmissions (T): For each data transfer stage, the number of transmissions is assigned by the BS. According to the network conditions and current energy levels, the value of T can be adjusted. Larger values of T indicate that the result of the GA will be used for a longer period of time. Hence from the history of previous GA solutions, the quality of best chromosome is determined. [7]

2.3 MRPSO (Moderate Random Particle Swarm Optimization)

It is to improve the convergence rate for particles. Therefore MRPSO is categorized into two operator, local operator & global operator. Global operator helps to build up the global search ability of MRPSO and local operator has capability to search particles in the local area. In this strategy velocity updated is not required, only position is updated. Position of the particle can be calculated as: new algorithm in which global search ability is increased &

$$X(t+1)(1 + w - \emptyset_{1\_}\emptyset_2)X(t) - wX(t-1) + \emptyset_1 P_p + \emptyset_2 P_g \quad (4)$$

The place of the dth element of the particle at the (t+1)th iteration can be calculated as:

$$X_{id}(t+1) = p_d + \alpha\gamma\left(mbest_{id} - x_{id}(t)\right) \quad (5)$$

Attractor is used as the major moving direction of particles. best position shown by mbest gives the step size for position of particles and take the help of all pbest to the evolution of particles. It improves the searching ability and diversity of particle. mbest equation is as following:

$$mbest = \sum_{i=1}^{s} \frac{p_{pt}}{s} \quad (6)$$

Where S is the population size in MRPSO.The convergence rate is the factor which acquires manage in the MRPSO as its accurate value is important. It enables particles to have a less exploitation ability, if convergence rate has a larger value and also particles enables a more exploitation ability if convergence rate has a smaller value .γ is a MRS operator because it enables the MRPSO to search more accurately than PSO.

2.4 Proposed work

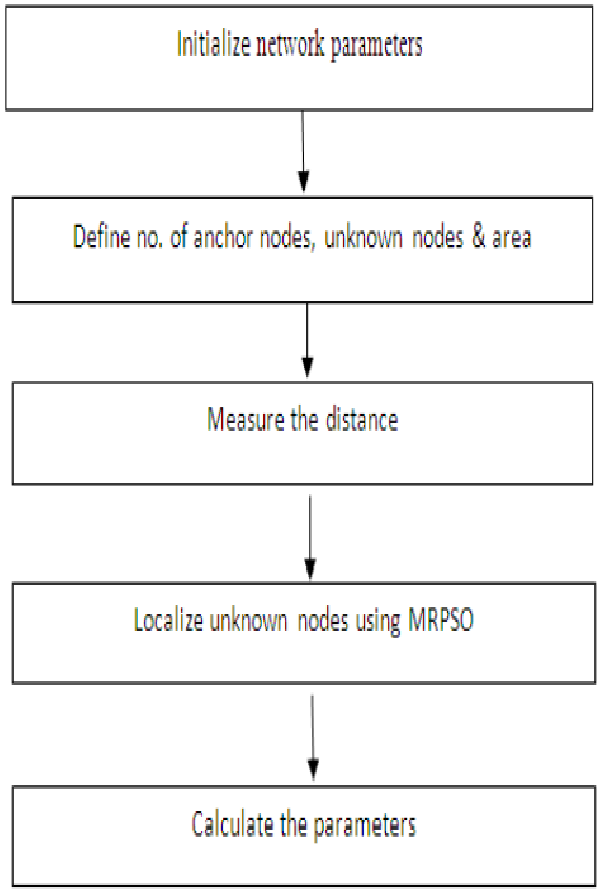

Fig 3. Flow Chart of Proposed Work

3. ENERGY MODEL ANALYSIS

This paper analysis GA and MR-PSO based on the energy dissipation mode shown in the following figure. For a particular node, due to receiving and transmitting the energy is dissipated. The energy is expanded in transmitter to transmit k-bit message is as follow

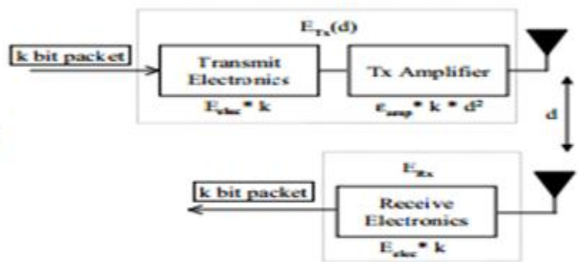

Fig 4. Energy Dissipation Model [11]

ET(. k,d) = (Eelec * k) + (Efs*k*d2)

d<=d0

(Eelec * k) + (Emp*k*d4)

if d>d0

- Eelec - Energy dissipated to run the electronics circuits
- k - packet size

- Efs and Emp - Characteristics of the transmitter amplifier
- d - Distance between the two communicating ends.

Energy dissipation to receive a k-bit message is given by-

ER(k) = Eelec* k

The values of radio characteristics are

Eelec = 50 nJ/bit

Efs = 10 pJ/bit/m2

Emp = 0.0013pJ/bit/m4

4. CONCLUSION

In this paper, Genetic Algorithm is proposed to search energy-efficient clusters for sensor networks. Total energy consumption is concerned with the number of cluster-heads and their position. Therefore, it is important to find out an energy-efficient clustering method. So, as the first objective, an optimal number of cluster-heads and optimization of number of cluster members of each cluster-heads is generated. Regarding second objective, the distance for data transmission between sensor nodes was taken to evaluate the fitness of a network. By this function, we the cost of transmission is minimized in network. MRPSO algorithm is proposed for distributed node localization in Wireless Sensor Network. Every unknown node performs localization under the measurement of distance from three or more neighboring anchors. The localized node is used as an anchor for remaining unknown nodes. Calculation of distance between the anchor & unknown is done using the objective function.

In this paper implementation of GA and MR-PSO algorithm is there and comparison of their performance using factors average energy and lifetime of nodes (dead nodes). In above Literature we have obverse that genetic algorithm provide minimum power energy consumption in Wireless sensor area network as compare to MR-PSO optimization method.

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