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Survey paper on Optimization of Wireless Sensor Networks using Artificial Intelligence Techniques

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ABSTRACT: The WSN is the network of sensor in which each node can collect and forward data to his neighbor node or to sink node say base station. The genetic algorithm formally used for creating and re-initiating the cluster based WSN in which it optimizes the network while network establishment. Optimization done in such way that the networks itself find his cluster head and leaf node of network by using fitness function. The dormant parameters, connectivity parameters and energy parameters play precise role to form fitness function to validate WSN. In advance to the genetic algorithm for forming energy efficient network particle swarm optimization computational method came into picture. Particle swarm optimization internally uses candidate solution to find feasible solution to get strengthen particle out of all swarm particle say node to establish WSN.

KEYWORDS: Wireless Sensor Network; Optimization Systems; Genetic Algorithm; Particle Swarm Optimization

I. INTRODUCTION

A wireless sensor network is the network of sensor node without wired communication between the nodes. A wireless sensor network (WSN) typically consists of a sink node sometimes referred to as a base station and a leaf node say small sensor node. The base station is assumed to be secure with unlimited available energy while the leaf nodes are assumed to be unsecured with limited available energy. The sensor nodes including cluster node, leaf node monitor a geographical area and capture data say Sensory information. Same information is communicated to the sink node through secure wireless mesh networks. To conserve energy this information is aggregated at intermediate sensor nodes say cluster head by applying a suitable aggregation function collected data across from whole network. Intention behind aggregation is to reduce the amount of network traffic which helps to decrease energy consumption on sensor nodes. Providing security to aggregate data in wireless sensor networks is known as secure data aggregation in WSN.

We can optimize the wireless sensor networks stages such as node placement, network coverage, clustering, data aggregation and routing by using genetic algorithm. And by using particle swarm optimization these stages gives optimized results with efficiency, accuracy and speed.

A. *DOMAIN INTRODUCTION*

Wireless sensor networks (WSN), sometimes called wireless sensor and actuator networks (WSAN), are spatially distributed autonomous sensors to watch physical or environmental conditions, like temperature, sound, pressure, etc. and to hand and glove pass their information through the network to a main location. The lot of trendy networks square measure bi-directional, conjointly facultative management of sensing element activity as shown in Fig.1. The event of wireless sensing element networks was actuated by military applications like parcel of land surveillance; these days such networks square measure utilized in several industrials and shopper applications, like process observance and management, machine health observance, and so on.

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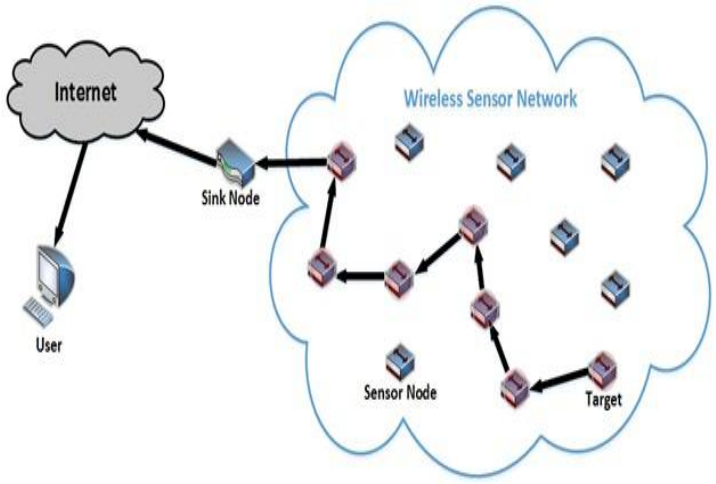

Fig.1. Wireless sensor networks Architecture

(a) The WSN is made of "nodes" from many to many tons of or maybe thousands, wherever every node is connected to 1 (or typically several) sensors.
(b) Every such sensing element network node has generally many parts: a radio transceiver with an enclosed associate degreetenna or affiliation to an external antenna, a micro-controller, and associate degree electronic circuit for interfacing with the sensors associate degreed an energy supply, sometimes battery or associate degree embedded style of energy gathering.
(c) A sensing element node would possibly vary in size from that of a shoe box right down to the dimensions of a grain of mud, though functioning "bits" of real microscopic dimensions have nonetheless to be created.
(d) The price of sensing element nodes is equally variable, starting from many to many green-backs, counting on the complexness of the individual sensing element nodes.

II. RELATED WORK

The paper offered by the Zhen-Lun Yang, Angus Wu, and Hua-Qing Min in 2016 delivers us through the deployment problem of WSN for real time oilfield monitoring in real world. Here need to install all network including sink and cluster node. The major concern of the manufacture of the monitoring system is the optimum placement of data delivery sub system to certify the full connectivity of the sensor nodes while keeping the construction cost as low as possible, with the least construction and maintenance complexity. Due to complicated landform network creation is complex task. The deployment problem is answered there using the approach of multi-objective discrete binary particle swarm optimization to produce optimal solutions from the minor financial cost to the minor complexity of construction and maintenance [1].

In the paper offered by Ali Norouzi and A. Halim Zaim in 2014 tell us about quality constraints like lifetime of network and energy consumption for routing are key factor for any WSN application. Genetic algorithm is one of the nonlinear optimization methods that cover all mentioned quality parameters. The present survey cover formal stages of WSN creation such as node placement, network coverage, clustering, and data aggregation and one of the precise aspects is routing in WSN. Using fitness method of genetic algorithm we did optimize and customized operational stages of WSN [2].

A.H. Mohamed, K.H. Marzouk in 2015 focuses on energy consumption in WSN. In this paper, the author introduces a new system that uses genetic algorithm (GA) for optimizing the node deployment, node locations and dividing the sensor nodes into two form of operation that can minimize the energy consumption of the WSN. Recommended system has been applied for a simulated WSN used in the radiation discovering sites as proof of concept in industry standard we can say it as case study [3].

The author Mohammed Abo Zahhad, Sabah M. Ahmed, Nabil Sabor, Shigenobu Sasaki presents a new Genetic Algorithm-based Energy-Efficient adaptive clustering hierarchy Protocol to increase stability and efficiency in WSN.

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The new protocol is aimed at extending the lifetime of WSNs by outcome the optimum number of cluster heads (CHs) and their locations based on minimizing the energy consumption of the sensor nodes using genetic algorithm. The operation of the Genetic Algorithm-based Energy-Efficient adaptive clustering order Protocol is broken up into rounds, where each round begins with a set-up phase, when the base station finds the optimal number of CHs and assigns members nodes of each CH, followed by a steady-state phase, when the sensed data are transferred to CHs and collected in frames, then these frames are relocated to the base station. By using design simulation they show that Genetic Algorithm-based Energy-Efficient adaptive clustering hierarchy Protocol improves the WSN lifetime and stability [4].

The author Jin Wang, Yiquan Cao, Bin Li, Hye-jin Kimb, Sung young Lee proposed Particle swarm optimization based clustering algorithm with mobile sink for WSNs. They determine that fixed sink node often suffer from hot spots problem since sensor nodes close to the sink usually have more traffic burden to forward during communication process. Utilizing mobile sink has been shown as an effective technique to enhance the network performance such as energy productivity, network lifetime, and latency etc. So author propose a particle swarm optimization based clustering algorithm with mobile sink for WSN. In this algorithm, the virtual clustering technique is performed during routing process. The remaining energy and position of the nodes are the primary parameters to select cluster head. The control strategy for mobile sink to collect data from cluster head is well designed. Extensive simulation results show that the energy consumption is much reduced, the network lifetime is extended and the transmission delay is compact [5].

The author Devi Manickavelu and Rhymend Uthariaraj Vaidyanathan projected conventional mobile ad hoc network (MANET) systems' route rediscovery methods; there occurs route failure in all route discovery methods resulting in data loss and communication expenditures. Hence, routing should be done in mobile sensor network form. So by seeing above clarification particle swarm optimization lifetime prediction algorithm for route recovery exposed. This technique predicts the lifetime of link and node in the available bandwidth based on the parameters like relative mobility of nodes and energy channel rate etc. Using predictions, the parameters are fuzzified and fuzzy rules have been formed to decide on the node rank. This information is made to exchange among all the nodes. Thus, the rank of every node is verified before data transmission. Even for a weak node, the performance of a route recovery mechanism is made in such a way that equivalent routes are diverted to the strong nodes so communication overhead get decrease rapidly [6].

III. PROPOSED ALGORITHM

We proposed the work i.e. particle swarm optimization which gives better results from the existing system. PSO also provides simplicity, fast convergence and ease of implementation in hardware and software. The WSN in which each node can collect and forward data to his neighbor node or to sink node say base station. The genetic algorithm formally used for creating and re-initiating the cluster based WSN in which it optimizes the network while network establishment. Optimization done in such way that the networks itself find his cluster head and leaf node of network by using fitness function. The dormant parameters, connectivity parameters and energy parameters play precise role to form fitness function to validate network. In advance to the genetic algorithm for forming energy efficient network particle swarm optimization computational method used. Particle swarm optimization internally uses candidate solution to find feasible solution to get strengthen particle out of all swarm particle say node to establish WSN. The operational stages of WSN are node placement, network coverage, clustering, data aggregation and routing can be achieved by using particle swarm optimization in less time and with speed.

PSOs don't change the populace from generation to generation; however keep a similar populace, imperatively redesigning the places of the members from the population (i.e., particles). PSOs have no administrators of “mutation”, “recombination”, and no idea of the “survival of the fittest”. Then again, likewise to GAs, a vital component of PSOs is that the members from the populace “interact”, or “influence” each other.

Particle swarm optimization algorithm is used in this concept as our proposed system because of the following reasons:-

- It gives simplicity, high quality of solution.
- It also provides fast convergence, insignificant computational burden.
- PSO solves the problems of static deployment, localization and clustering.

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- It gives ease of implementation on hardware and software.

Hence, due to the above advantages, PSO is developed in our system.

The following Five steps which show us actual network creation and network optimization:-

A. *Node Placement:*

Node placement is the placement of the node in the network to ensure that system keeps running with the most noteworthy practical execution, the nodes are situated on the grounds organizes. A few types of network node arrangement are Grid and so on. By using PSO algorithm, the node can be placed optimally in the specified area.

B. *Network Coverage:*

Network Coverage is the term particularly inferred for keeping up and measuring the physical areas of networks. Really Network Coverage intends to associate the network indiscriminately and exactly so all network siblings get associated with Sink node say base station for network message correspondence. Network Coverage has done moving the nodes by considering every node bit by making it on and off say 0 and 1. Network coverage method mostly uses in the clustering to maintain the networks with synchronization and to easily send the data from one node to other node.

C. *Clustering:*

For making the networks very load balance clustering come into picture. By utilizing fitness function we will accomplish the clustering. Clustering is the stage in which packet forwarding problems are easily solved. When we use packet forwarding method, the time, energy, delay and packet delivery ratio entities are more so to avoid these problems clustering is proposed.

D. *Data Aggregation:*

Data Aggregation makes it simple to gather every single sensible data from all networks including all clusters and his cluster member. Data Aggregation certifications to convey exact information to sink node say base station. Another pour stance is to dole out or choose load to the node in the network. Additionally, help GA to make the load balance network. By utilizing energy consumption we unequivocally do Data Aggregation in the network to oversee load balancing of network. While in case of PSO also the data aggregation is used to make the load balance and to transmit the data.

E. *Routing:*

At long last from fitness function routing protocol take some parameter to pick the optimum route to travel to every part of the entire WSN. Regularly routing fitness function consider three conditions of energy they are called

- Low communication range
- Middle communication range
- High communication range

Using above range routing algorithm decide route to travel toward sink node.

IV. ALGORITHMS

In this artificial intelligence techniques are used for the optimization of wireless sensor network stages. The genetic algorithm is used in the existing system to provide the optimization and particle swarm optimization is used to achieve the simplicity, fast convergence and ease of implementation.

A. *GENETIC ALGORITHM:*

Genetic Algorithms (GAs) are versatile heuristic pursuit calculation in view of the trans-formative thoughts of regular determination and hereditary qualities. All things considered they speak to a keen abuse of an arbitrary pursuit used to take care of improvement issues. GAs reenacts the survival of the fittest among people over continuous era for tackling an issue. Every era comprises a populace of character strings that are similar to the chromosome that we find in our DNA. Every individual speaks to a point in an inquiry space and a conceivable arrangement. The people in the populace are then made to experience a procedure of development.

Flowchart of Genetic Algorithm:-

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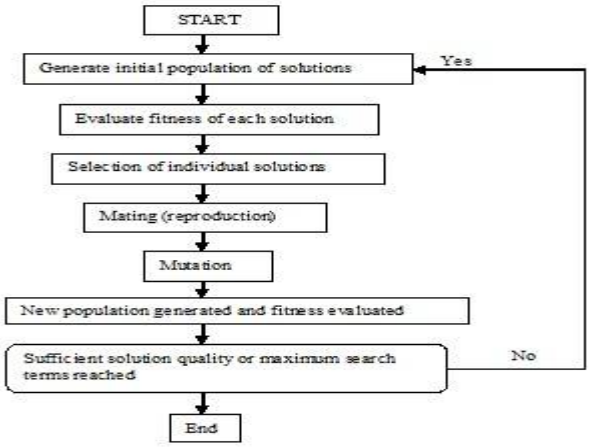
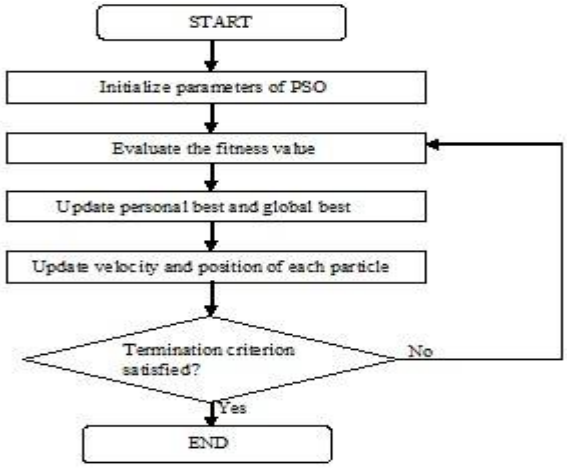


Genetic Algorithm works as:-
Step 1: [Start] Generate irregular populace of n chromosomes (appropriate answers for the issue)
Step 2: [Fitness] Evaluate the fitness f(x) of every chromosome x in the populace
Step 3: [New population] Create another populace by rehashing taking after strides until the new populace is finished
Step 4: [Selection] Select two parent chromosomes from a populace as per their fitness (the better fitness, the greater opportunity to be chosen)
Step 5: [Crossover] with a crossover probability cross over the parents to form a new offspring (children). In the event that no crossover was performed, offspring is a precise of parents.
Step 6: [Mutation] with a mutation probability mutate new offspring at each locus (position in chromosome).
Step 7: [Accepting] Place new offspring in another populace
Step 8: [Replace] Use new generated population for a further run of algorithm
Step 9: [Test] if the end condition is fulfilled, stop, and give back the best arrangement in current populace
Step 10: [Loop] Go to step 2

B. ***PARTICLE SWARM OPTIMIZATION:***

PSO is swarm intelligence meta-heuristic inspired by the gathering conduct of creatures, for instance bird flocks or fish schools. Thus, to genetic algorithms (GAs), it is a population-based strategy, that is, it speaks to the state of the algorithm by a populace, which is imperatively altered until a termination criterion is fulfilled.

Flowchart of Particle Swarm Optimization Algorithm:-



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PSO Algorithm works as:-
Step 1: Initialization:

Including swarm size N, maximum number of iterations n, initial velocities v and positions x, c1 and c2.

Step 2: Loop:

- Evaluation: Evaluate each particle's position according to the fitness function
- Termination criterion check: If a criterion is met, exit loop.
- Find the personal best: Find the best solution of each particle so far (If a particle's current position is better than its previous best position, update it)
- Find the global best: Find the best solution of all the particles until now (Determine the best particle according to the particle's previous best positions)
- Update the velocities: Update the velocity of each particle.
- Update positions: Move particles to their new positions.

Step 3: Return to Loop

V. DISCUSSIONS

The literature survey tells us about the brief idea of the given approach. After going through each and every reference papers it is proved that the two separate artificial intelligence algorithms works in their own way. This also tells us about the different advantages of genetic algorithm and different advantages of particle swarm optimization algorithm. But when we use these both algorithms in one approach then our system is going to be developed.

The advantages of particle swarm optimization over genetic algorithm are described as follows:-

- PSO has turned out to be a speedier and more versatile arrangement contrasting with GA.
- In multi-objective optimization the solution strategies are more natural and the forefront of research on PSO is more dynamic contrasting with GA's that is by all accounts fading away.
- PSO does not have genetic operators like crossover and mutation. Particles overhaul themselves with the inner speed.
- They additionally have memory, which is important to the algorithm.
- Compared with genetic algorithms (GAs), the data sharing component in PSO is essentially distinctive.
- In GAs, chromosomes share information with each other. So the entire populace moves like a one group towards an optimal area.
- Compared with GA, every one of the particles have a tendency to focalize to the best solution immediately even in the local version in most cases.

The optimization stages such as node placement, network coverage, clustering, data aggregation and routing using particle swarm optimization can be optimized easily. In node placement, the nodes are optimized easily because the nodes are placed as particles. In clustering, the cluster heads are used to optimize and to send the data to sink node i.e. base station, who behaves as the coverage of network, and with the help of cluster members the broadcasting is done easily, the clustering can be achieved by APTEEN protocol. The data aggregation can be used to load balance, passing message from one node to other by using the particle swarm optimization. And the last stage i.e. routing can be obtained in the data aggregation stage where we need to send the data in the minimum distance.

The APTEEN (Adaptive periodic threshold sensitive energy efficient sensor network) protocol is the most advantageous protocol to form the clustering with the help of cluster heads. A responsive network protocol called APTEEN is Adaptive periodic threshold sensitive energy efficient sensor network protocol. Hybrid Networks join the best components of proactive and reactive networks, while minimizing their disadvantages. Nodes in such a network transmit information periodically at moderately longer intervals while in the meantime transmitting information when the detected esteem goes past its threshold. In this manner, the sensor energy is utilized effectively by decreasing the number of transmissions of noncritical information. The client can change the periodicity, threshold value(s) and the parameter to be detected in various regions. This network can copy either the proactive or the reactive network by reasonably changing the periodicity or threshold values. Along these lines, this network can be utilized as a part of an application by appropriately setting the different parameters. In any case, this adaptability and flexibility increases the complexity at the sensor. Here a new protocol APTEEN (Adaptive Periodic Threshold-sensitive Energy Efficient

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sensor Network Protocol) is presented for hybrid networks. There are applications in which the client needs time basic information furthermore needs to inquiry the system for examination of conditions other than gathering time basic information. APTEEN can consolidate the best components of proactive and reactive networks while minimizing their restrictions to make another type of network called a hybrid network. In this network, the nodes not just send data periodically; they additionally react to sudden changes in attribute values. Along these lines it acts as a proactive protocol and additionally reactive protocol.

Hence, these are the stages of wireless sensor network which can be optimized by using the particle swarm optimization.

The architecture diagram of the system shown below helps us to understand the system.

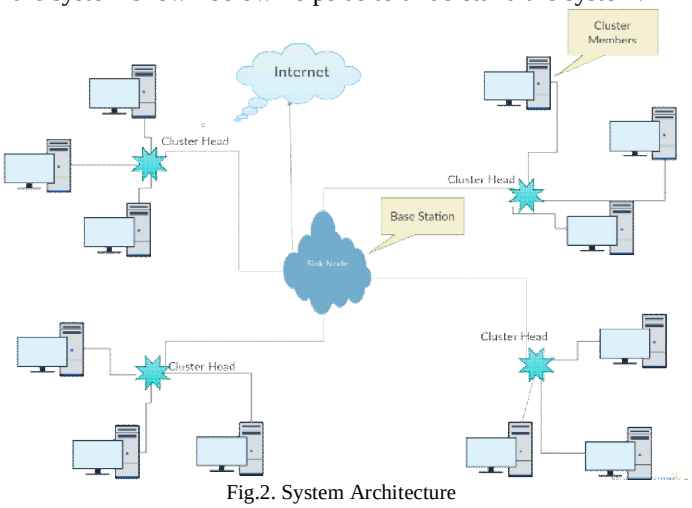

Fig.2. System Architecture

The above system architecture describes about our whole system which includes the 5 stages of WSN i.e. node placement, network coverage, clustering, data aggregation and routing. In above diagram, we can easily know that the main communication is going to start from the sink node i.e. Base Station (BS). Using this base station, the further communication is going too held in between the cluster heads and cluster members. Mainly the cluster heads and cluster members are playing the important role; if once this is properly done the rest stages can be easily implemented.

VI. CONCLUSION AND FUTURE WORK

Evaluating the energy limitations in WSN, genetic and Particle swarm optimization algorithms are used to optimize the WSN in case of network initiation and reformation in optimized manner. The approach of this paper is open bottom angle detection, as the features of the application requirements, communication constraints, and energy saving etc. This paper presents the design of energy optimization by optimizing the network nodes operating mode. The main approach of this paper is used to optimize the stages of wireless sensor networks by using the most optimized method i.e. particle swarm optimization. With genetic algorithms, Particle swarm optimization internally use candidate solution to find feasible solution to get strengthen particle out of all swarm particle reform optimized WSN. The PSO algorithm is the most convenient method to optimize the stages i.e. node placement, network coverage, clustering, data aggregation and routing. In the Future, we can propose the application based protocol in the military applications. Also, the encryption method can be used in the clustering so that the data can be send and receive easily.

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BIOGRAPHY

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