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Original Research

Application of Routing Methods to Reduce Energy Consumption in Wireless Sensor Networks

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Abstract
Today, due to fundamental advances in the field of integrated circuit design, wireless communications and sensor design, wireless sensor networks are highly regarded researchers in various industries. Increased lifetime in wireless sensor networks, without having the ability to replace and recharge the batteries, the issue has become a challenge for researchers. In this regard, many algorithms and methods are provided. In some cases, the problem of increasing energy consumption in the nodes level examined, in others the problem at the network level and have provided techniques for routing and reduce consumption. In this paper routing methods to reduce energy consumption and function of each is checked and then ALO meta-heuristic algorithm role in the global clustering and network with mobile base stations to reduce energy consumption is expressed.

Keywords: Wireless sensor network, cluster-head, reliability, energy hole, ALO meta-heuristic algorithm.

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Introduction

Nowadays remote control systems and monitor into one of the challenging issues in the field of electronics and computers have become. For awareness of changing environment and the status of each of the physical parameters of the sensors are used. Each of the sensors according to need can monitor specific parameters, such as temperature, humidity, pressure so a set of embedded sensors can monitor changes in the environment. Recently, progress has been made in the field of electronics and wireless sensors, and is the emergence of multi-purpose sensors with low power consumption. The sensors are able to communicate with each other over short distances. Each node is a very small sensor with measuring equipment, data processing and wireless communication. In fact, a sensor network is composed of a series of independent sensor that and with other nodes in the distributed environment to traverse a common goal to collect data from their environment. Nodes close to each other and each can communicate with other nodes accessible environment [1]. Techniques and methods used in wireless sensor networks is highly dependent on the type of application, network topology, environmental conditions, limits the efficiency and cost parameters. So today across major universities, research centers computers, electronics and communications, wireless sensor networks have become a fascinating field of research. Suggestions and research in many areas of sensor networks is presented that increase the volume of research in this field is sent.

The main target of all these efforts, providing ways that In addition to simple, essential requirements to be resolved at a low cost (bandwidth, energy and the environment), so the wireless sensor network could pursue its goal due to environmental conditions and the continuing, long- lifetime, low cost, and have a broadband connection [2]. Since the wireless sensor network technology batteries have failed to keep pace with the rapid development of electronics and telecommunications, Wireless sensor network nodes greatly in terms of energy supply for battery limits are in trouble. However, because of the high number of nodes in wireless sensor networks, access to them is difficult and there is no possibility of changing them, this network is expected that no need to replace the power supply can continue to operate for many years. Data transfer one of the major issues affecting the energy consumption of wireless sensor networks. The task of a node in the network event detection sensors, fast processing and then transfer the data. The energy consumption is divided into three parts: Sensing, Data processing, Wireless communication. Of the three divisions that in the sensor node energy consumption, most energy is spent in communication that including sending and receiving data packets is also included. It can be shown that in the short-range communications capability (0 DBM) send and receive approximately the same amount of energy consumed. So if the traffic load on the network is well distributed, power consumption of the entire network broadcast as a result, the network lifetime will go up. The main target of most studies done in the field of wireless sensor networks to reduce energy consumption and at the same time extend the lifetime of the network. One of the popular techniques for reducing energy consumption, clustering [1]. In Figure 1, an example of clustering in sensor networks is shown.

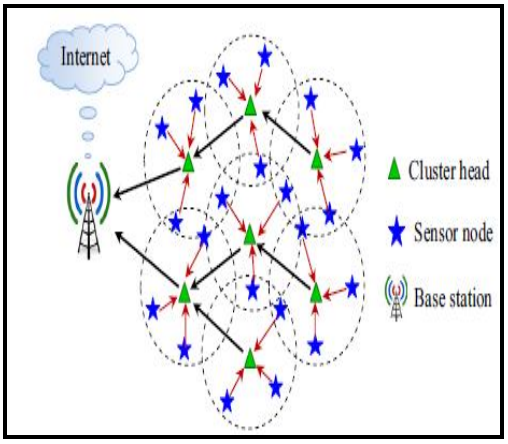

Figure 1: An example of clustering in sensor networks [1].

In each cluster, a node as cluster head and there are a number of nodes to the cluster members.CH responsible for condensing the data collected from the members of the cluster and Is responsible for transferring it to sink. CH selection can be centralized or distributed. In addition to reducing energy consumption clustering, scalability increases. Clustering also reduces bandwidth consumption and increases the stability of the network topology. Select the appropriate cluster has a significant impact on reducing energy consumption. In recent years, extensive research has been conducted on the mechanisms of the cluster in wireless sensor networks.

So this paper presents an overview on clustering based routing techniques will be for reducing power consumption in wireless sensor network and more precisely, with a deeper look at the issue of energy consumption in sensors, energy consumption and cluster members, energy consumption and CH and challenging issue of energy holes as uneven clustering based routing protocol inspired by the new

algorithm-ALO to solve the energy hole, we will continue to reduce energy consumption.

2. Low Energy Adaptive Clustering Hierarchy Algorithm: (LEACH)

The algorithm LEACH [3], a routing algorithm that is used to collect and deliver data to a base station is designed. The main targets of this algorithm increases network lifetime, reducing energy consumption for each sensor node and the community and compaction data communication is to reduce the number of messages. The algorithm consists of two operational phase is set-up and steady-state (figure 3-1). Start-up phase composed of the two-stage Select the cluster head and the cluster is made up. During the start-up phase is relatively shorter than the steady-state phase and the aim is, Protocol overhead is minimized. The algorithm is assumed each sensor node is able to that send data to the base station and nodes that are able to control their transmission power. Each node also has the MAC computing power needed to support different protocols.

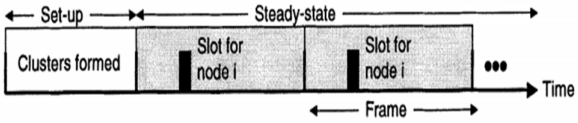

Figure 2: The Timeline algorithm LEACH [3].

The algorithm LEACH, compared with previous methods, such as sending flood of data, causing enormous savings in energy consumption. The amount of energy savings, depends on the volume of data collected by the cluster head. But the main problem of this algorithm is that sink assumes that all nodes can access directly. But in practice, this supposition can't be implemented in a network with a distance of many kilometers. Because with increasing distance consumer spending increased for the transfer of information and energy consumption increases. The advantages of this method of energy balance sensor. Disadvantages of this method of energy loss due to the implementation of clustering algorithm in each round and imbalances in the cluster.

3. Greedy Load-Balanced Clustering Algorithm: (GLBCA)

The algorithm GLBCA [4], load balancing clustering algorithm is a greedy. GLBCA algorithms target to balance the load on the gateway nodes and balanced clustering, to enhance system stability and improve communication between different nodes in the network. GLBCA algorithm to minimize the maximum load on the gate uses two ideas:

1. Each sensor node must belong to only one cluster.
2. The maximum network gateways in the network. Therefore, the load on the network between all nodes is played. The advantage of this algorithm is to do it in exponential time and clustering Techniques, the node network load-balanced cluster head for playback. Disadvantages of this method of analysis, the average efficiency of the algorithm, using a centralized approach, being aware of the complete topology each node of the network and its lack of scalability.

4. Centralized Routing Algorithm Based On Genetics

To schedule data collection by relay nodes to a centralized routing algorithm based on genetic algorithm is presented [5]. The target genetic algorithms find a sensor network is scheduled for collecting data in such a way that network lifetime maximum. It is calculated by the number of cycles during the lifetime of a network. This algorithm significantly increases the lifetime of a sensor network. For small networks that it is available in local optimum these algorithms can be optimized solutions and for large networks also finds a good solution. Fitness function in this algorithm is calculated based on the life of the network. This value is obtained by the number of cycles performed.

$$L_{Net} = E_{initial} / E_{max} \quad (1)$$

In this equation L represents the lifetime of the network is based on the number of rounds. It also E shows the primary energy cluster head node it has been proposed amount E is specified and its value is identical for all nodes. E maximum power consumption is a cluster head node. Although this method uses a focused approach, it is possible that a limited number of dynamic routing can be re-imposed on the model. This method is useful that a node due to the completion of energy from outside the network. This method can also be based on the

current state of the network, routing Scheduling do in very little time. The disadvantage of this algorithm can be fixed nodes and lack of attention to network changes noted.

5.LEACH-ER Algorithm

In order to reduce energy consumption in sensor network, a new algorithm named LEACH-ER is suggested that using this method can reduced energy consumption and to maximize the network lifetime. Also in this way the reliability of the network has increased [6].

LEACH-ER algorithm when sending data of mechanism makes use in the name of differentiation in service. Differentiation in service protocol that for specify and control network traffic based on specific class designed, so a specific traffic type can have greater priority. Differentiation in service is the most advanced way for managing traffic. So considering the mechanism of Differentiation in services in step data transmission, reliability network improved. Also in this algorithm because of the use of data structure with four field (node identities (ID), energy node (ENG), specify of cluster head node with a value of 1 (FLAG), field pointer to the next node) for nodes in the cluster, causing reduce the number of messages sent between the cluster head and members of the cluster that cause the overhead in the network be reduced that advantages algorithm is considered. The disadvantages of this algorithm, lack of a balanced load distribution between nodes in the cluster, low convergence time, lack of stability of the algorithm and lack of resistance in front errors.

6.N-LEACH Algorithm

Algorithm N-LEACH [7], algorithm is an algorithm based on LEACH that like LEACH algorithm to periodically acts and per round its contains two operational phase is clustering and stable data transmission. Clustering operational phase, including two-stage is the CH selection process and creates a spanning tree. CH selection process, in the first round, cluster head be chosen by the central station and in the next period will be determined by the amount of residual energy of each node and node with the greatest amount of energy in the last round as cluster head be selected.

In the next step should be creating a spanning tree. For this job, each cluster head node, her father will be selected with this method: The first cluster that is close to the base station is the root cluster. Cluster head corresponding to cluster-roots, the base station selects as a parent node.

If the cluster head i was a non-root nodes, then node i, node cluster-head roots as her father does selection. Otherwise, node *i*, one other node to the name *j* that shortest distance to with root as the parent node dose selection. After all cluster head chose itself root node, the results be sent to cluster head-root node. Based on parent-child relation, Cluster head -root node topologically all nodes in head cluster dose arranged. So, parent node after the child nodes are placed. Cluster head-roots node, respectively timescales allocates to send and receive nodes data and TDMA scheduling sends to all the cluster head.

In phase stable data transmission, CH in all the periods of time must is wait to receive the package. In any period of time a node sends data to the cluster head. When all the data were received, cluster head node them processes and in the path spanning tree created, sends them to the base station.

The advantage of this algorithm, is balance in the load flow traffic between cluster head. Disadvantages algorithm, the lack of scalability and lack of stability against errors occurring in the network.

7.Learning Automata-Based Clustering Algorithm (LACA)

Clustering algorithm based on learning automata called LACA [8], an algorithm is fully distributed and independent of network size. This algorithm can improve energy consumption. In this algorithm, the base station location is predetermined.

LACA algorithm is composed of two operation phases, set-up and steady-stable. In this algorithm, it is assumed that the energy of each node is *1.0J* and each sensor node is equipped an automaton with r action $\{a_1, a_2, \ldots, a_r\}$ that where r is the number of neighboring nodes. *P*, probability vector selection action learning automata that *Pi* is the probability of selection procedure i.

Learning automata each node, by using his action selection probability vector (P) Select one of the neighbors as CH and IEY message to it sends. If the receiver IEY, is not a member of any cluster and its energy is equal to or greater than the threshold identified, then based on the learning algorithm, it rises the probability of selection. Otherwise this

amount will be reduced. Then, if a node does not have a neighbors, selects itself as a cluster head.

If a node IEY message from a neighboring node receives and not already any cluster member, selects as his cluster heads and otherwise if been already a member of another cluster or have previously been the cluster head of a second cluster, then IEY's the message ignores.

In the start-up phase, in the first round using clustering algorithms, the network is divided into different clusters and based on cost and to consider CH as collector information, doing centralized routing and several constitutes a step. But in the next period is not required to create clusters and only cluster will be selected.

After selecting the cluster, multi-step routing begins. In phase send data (steady state), each cluster head the received data from the sensor nodes collect and processing and according to path created by the base station sends data. In phase send data (steady state), each cluster head the received data from the sensor nodes collect and processing and based on the path created by the base station sends data.

8.A-LEACH Algorithm

Algorithm A-LEACH [9], a more advanced algorithm is LEACH algorithm. A-LEACH routing method is based on the around and each round in two operational phase done start-up and steady-state. Each node using the synchronous clock, since the start of each round is aware.

Also in the algorithm, energy all nodes identical is not considered and a number of nodes have more energy. Nodes that have more energy called the CAG. CAG nodes will be gateway with the exception of nodes that in the current round are cluster heads. So CH has two nature or a normal node or a node is CAG. At the beginning of start-up phase, a round of choice of CH as LEACH algorithm is performed. For the current round, each sensor node that that tries is CH to send a broadcast message to (m-1) * n the next node and tells to them that will be CH. Then, nodes based on the signal power received to join a cluster.

Each node in the steady-state phase, sends the collected data to the CH. After this that cluster head received data, them collect and based on the nature of the cluster head sends them to the central station.

- If CH is a normal node, find the closest node to CAG and it will selects as the gateway for data transmission to the base station.
- If CH is a node CAG Then sends the data directly to the base station.

The advantage of this algorithm is that because of there are parameters such as homogeneity of the network, has been reduced error probability nodes. Also because the choice of CAG CH nodes, the possibility of CH node failure is reduced. Among the disadvantages of these algorithms can be no stability against errors noted the lack of scalability.

9.Energy-Aware Evolutionary Routing Protocol (EAERP)

The algorithm EAERP [10], a routing evolutionary algorithm based on clustering that in order to achieve a protocol that can be in terms of sustainability, lifetime and energy consumption, have the results more reliable and better than other innovative algorithms and innovative offers a new objective function. So this algorithm working on the basis of communications one step. Also this algorithm can be create a better conciliation between lifetime and sustainability of the network and use from energy effectively. The algorithm of two operational phase selection CH and routing is formed. Also in this method of 2 channel model, free space and multipath fading to calculate the amount of energy waste is used when sending and receiving information. CH selection phase, clusters are created using the centralized evolutionary algorithm. From the standpoint of evolutionary algorithms, a full clustering routing solutions as a member of the population is considered (I). For a network with N sensor nodes, the agents in population are consists of N gene. Its values can be used to state that a node is CH, 1 and otherwise, its value is zero. A population I^n of possible solution, is as follows:

$$\forall i \in \{1,..., n\} \text{ and } \forall j \in \{1,..., N\}$$

$$I_j^i = \begin{cases} 1 & \text{if } E(\text{node}_j) > 0 \text{ and node}_j = CH \\ 0 & \text{if } E(\text{node}_j) > 0 \text{ and node}_j = \text{non} - CH \\ -1 & \text{otherwise .} \end{cases} \quad (2)$$

Every member of the population randomly with a probability p, that amount desirability of a node for cluster being shows is initialized.

$$I_j = \begin{cases} 1 & if\ E(node_j) > 0\ and\ node_j = p \\ 0 & if\ E(node_j) > 0\ and\ node_j = 1 - p \\ -1 & otherwise. \end{cases} \quad (3)$$

The showing method, implicitly, shaping variable number of the CH during the entire periodic routing protocol does simpler. For EAERP, the objective function is proposed for minimizing the total energy wasted in the network can be defined. Fitness function used for assess members of population of the I^K, ∀ K ∈ {1,…, n} EAERP Protocol will be as follows.

$$\phi_{EAERP}(I^K) = \left(\sum_{i=1}^{nc} \sum_{s \in c_i} (E_{TX_{s,CH_i}} + E_{RX} + E_{DA}) \right) + \sum_{i=1}^{nc} E_{TX_{CH_i,BS}} \quad (4)$$

In the above equation nc the total number of CH, S ∈ ci Non-cluster head nodes that are members of the cluster i, ETXnode1, node2 the amount of wasted energy to sending data shows from node1 to node2. The initial population of chromosomes will be created and each member of the population will be assessed by the fitness function. Then, the agents in population by evolutionary operations such as, selection, combining and mutating recover. The operation as long as limitations are not completed will continue. The proposed algorithm because doing clustering process and routing has been able very will reduce network energy consumption.

Also in the algorithm has been able to greatly have improved network throughput. The disadvantages of these the algorithm using one step routing method and lack of use of new exploration target function.

10. Mimetic Algorithm Based On Differential Evolution

Mimetic algorithm [11], one population-based algorithm that for large and complex optimization problems is used. The main idea of this algorithm, using a local search within the structure of the genetic algorithm to improve the efficiency of process intensification during the search.

In this algorithm, it is assumed sensor nodes, are static and not have move. The nodes have been organized in clusters that each cluster has a cluster head. Cluster head node, data receive from the nodes inside cluster and after aggregation the data, sends them to the central station. Also in the algorithm it is assumed cluster head nodes have more energy than other nodes.

Mimetic algorithm in their core is a differential evolution algorithm. Differential evolution algorithm is one of the newest evolutionary algorithms. Differential evolution algorithm in order to overcome the main disadvantage of genetic algorithms, namely a lack of local search has been created and its main difference with GA is in the selection operator. In Genetics the chance to choose an answer as one of the parent it is dependent upon the fitness function but in the differential evolution algorithm all answers have an equal chance for selection and do not depend to amount their fitness function. Another advantages of algorithms based on differential evolution algorithm like mimetic on evolutionary algorithms such as genetics, having memory is that all right answers keeps in the current population, and after this that a new answer was created using the process mutation and composition then new answer was compared to the previous value stored in your memory and if it was better, will be replaced.

In the next stage that assessment of the population from a fitness function are used for this work. In the full path, with the start of each cluster node and with the aim of reach the base station, maximum energy consumption are calculated. So the objective fitness function in this algorithm, achieving a path that minimizes the amount of E_{max}.

$$E_{max} = \max_i \{E_i, 1 \le i \le n\} \quad (5)$$

The algorithm is able by using differential evolution algorithm each time to reach better solutions. Also other advantage of this algorithm its high scalability. The disadvantage algorithm are the constancy of the nodes and being aware of situation and the condition of the network.

11. Approximate Clustering Algorithm (ALBC)

Approximate clustering algorithm (ALBC) [12], is a load balancing clustering method for sensor networks. The ALBC algorithm, is optimal for state that sensor nodes are in load balanced. There is an approximation algorithm called approximation-2

algorithm that for state that the sensor nodes not have variable load and approximation-1.5 algorithm is for the general case.

The goal of both algorithms is improve efficiency of algorithms for load balancing cluster head, the runtime and the lifetime of the network. In this algorithm, the sensor nodes are distributed randomly in a space and gateway nodes are previously determined and are selected as the CH. A sensor node can to each node gateway that in the transmission range is be allocated and gets its member. The corresponding algorithm for state that at that is identical load nodes it's like this $d_i = a$, $\forall s_i \in S$ $i \leq n \leq 1$. So minimizing, the maximum amount of load each CH equal to by minimizing the maximum number of sensor nodes that can be assigned to a cluster. In the approximately -2 the idea that is used in order to balance load cluster head, this is that set of sensor nodes S, in the form of non-additive and based on gateway $|G_i|$ each sensor node s_i, $\forall s_i \in S$, $i \leq n \leq 1$ ordered. If $S = \{s_a, s_b, s_c, \ldots, s_p\}$ is list sorted by sensor nodes, With the start from the first node, nodes be assigned to the appropriate CH. For example sensor nodes s_a be assigned to the cluster head that EL have lowest value. s_a if CH's like g_x selects then:

$$EL(g_x) = \min\{EL(g_k) \mid \forall g_k \in G_a\} \qquad (6)$$

If the EL was equal for several cluster head then CH will get selection that it's more probability join nodes. If all of them probability having same, then CH gets selection that the number of nodes to which they have been allocated less.

After assigning each node, the amount of EL cluster head by equation (2) gets updated. Also for assign the next sensor node of lists sorted from equation (3) are used. This process will continue until that all sensor nodes be assigned to appropriate cluster head.

$$EL(g_x) = EL(g_x) + 1 - P_i(x) \times d_i \qquad (7)$$

$$EL(g_y) = EL(g_y) - P_i(y) \times d_i, \quad \forall g_y \in G_i - \{g_x\} \qquad (8)$$

The idea of approximation -1.5 this is that is assumes to be network load is not distributed between nodes to equilibrium and clusters have been formation already. So first of all sensor nodes, si $\forall si \in Rse$ have been assigned to their respective gates. Then all sensor nodes, s_j $\forall s_j \in Q_{set}$ for non-decreasing and sorted based on traffic load. Then a sensor node that containing the most load traffic to CH with lowest traffic load that in their transmission range be assigned.

After this stage, current load and the maximum load possible to the next cluster head will be updated. This process will continue until that all sensor nodes assigned to the cluster head.

Both algorithms approximately-2 and approximately-1.5 have been designed for balance the load on the network so for load balancing between nodes in these two algorithms used equilibrium clustering techniques.

The disadvantage of this type of algorithm are disregarding to distance between nodes and also the amount of residual energy of each node in different periods.

12. The Routing Algorithm GAR:

Routing algorithm GAR [13], is a method based on genetic algorithm. The algorithm tries by reducing passed way by data, reduce the energy consumption of sensor nodes. GAR algorithm can be based on the current state of the network, create new routing schedule.

This algorithm effective calculating the advantage of genetic algorithm for find a quick solution uses. GAR algorithm to be centralized operates. Also it is assumed in this algorithm already been created clusters and replay nodes are clear. Replay nodes using a positioning system (GPS) know your exact location.

Methods based on genetic algorithms, are adaptive methods that can for to be used to solve optimization problems. Genetic algorithm with a set of possible solutions that are randomly generated, start to working. The initial population, is random set of chromosomes that are consistent with a routing schedule. So valid chromosomes while arise that the amount of J a gene in the position i are randomly be elected that C_j = Next_Hop (C_i). C_i and C_j in this equation are replay nodes. A particular solution by a simple string or an array of chromosomes is displayed. When the initial population of chromosomes, were produced, two chromosomes that randomly are selected (parents), can using the crossover process in which parents are exchange their genetic information, two new chromosome (child) to create. To create new children of parents selected, are used One-Point Crossover operation. Crossover operation between the two chromosomes that randomly are selected will be done. In these algorithms to perform jumps, instead of doing

mutation random on gene, selective based on the genes.

First gene that path with maximum distance to the base station are creates had chosen and it is called the critical node. Instead of the critical node, the node be elected that will have least distance to the base station. Replacing one node can be done to this method. If the gene i leads to is greatest distance (Distance between C_i and other replay node are most), this algorithm are looking the other replay node will be in the name of Cr that C_i is a node-next. The fact that Cr is the closest to C_i it was implied that Dist (C_i, C_r) should be minimized. Also must total energy consumption of new replay node is less of other replay nodes. This means that $\{(\text{Dist}(C_i, C_r))^2\} + \{(\text{Dist}(C_r, B_S))^2\}$ should be minimal. Considering these two limitations, if Cr is elected as next replay node should $\text{Dist}(C_i,C_r) * \{(\text{Dist}(C_i,C_r))^2 + (\text{Dist}(C_r, B_S))^2\}$ is minimal.

The purpose of the algorithm, minimizing distance traveled for send data aggregated is relay nodes to the base station. So, in this way, fitness function is caused in circumstances that the distance traveled by the nodes in each round is minimized. Whatever transmission distance, is shorter, the fitness function is also higher. Any particular chromosome will be assessed by the following fitness function:

$$\text{Fitness}(k) = \frac{1}{\sum_{i=0}^{N-1} \text{Dist}(C_i, \text{Crom}(k,i))} \quad (9)$$

Function Fitness (k), k-the chromosome fitness value and Crom (k, i) the amount of gene i in K-th chromosome is showing. It is important due to this it that Crom (k, i) in fact next reply node, Ci- node in k chromosomes is showing. For the selection process, some of chromosomes that have highest fitness value will be selected.

In this algorithm of the tournament method for select chromosomes with the best fitness in the initial population are used.

All chromosome-chosen using crossover operations as parents to produce new child chromosomes are selected. One of the advantages algorithms can to calculate the physical distance between nodes can be mentioned. Because whatever interval between the source node and destination is more, to send data to the higher energy needs. Some disadvantages the algorithm, lack of attention to the residual energy of each node in the round and lack of attention to residual energy nodes.

In addition, to consider clustering with routing can improve network performance, but in this algorithm is not considered clustering of nodes.

In the efficiency function cluster head all clustering-based routing algorithms have been studied, parameters distance members of the cluster of cluster head and reliability (amount tolerance against downtime) cluster head network not been considered. In addition energy holes problem that leads to a reduction the lifetime of the network and increased energy wasted in the network have been considered. Parameters distance members of the cluster of cluster head in the clustering techniques cause reduces energy consumption. Because whatever distance members of the cluster of cluster head and also distance CH from the base station is less, then amount of energy used for data transmission in the network is reduced.

Also cluster head gates reliability parameter increases the scalability in the network. Because whatever the amount of tolerance against failure or error in CH gates is more, their lifetime of increases and can be in the longer period of time use a greater number of CH for data transmission and also provides scalable network. Energy holes problem is caused because there is existence many hot spots in the network. Hot spots, CH of network that are located close to the base station or on routes high traffic between the clusters. Networks in which there are hot spots, suffer from the problem of energy holes.

Energy holes means to premature death sensors that near the base station and within a radius transfer are located and other clusters traffic sends to the base station. In the event of the death this type of sensor, data distant clusters has not been sent to the base station and energy is consumed futile. Lack of attention to lack of attention to the problem of energy holes in routing algorithms have been studied causing energy in them consumed futile and finally in these types of algorithms energy consumption increase and are reduced the lifetime of the networks.

To fix the first flaw all routing algorithms have been studied, of cluster-based routing algorithms efficient energy inspired by particle swarm meta-heuristic algorithm [14] is used.

Table 1. Comparison of Routing Algorithms in Wireless Sensor Network

Algorithm	Advantages	Disadvantages
LEACH	Balance in energy consumption Sensors	1. Energy waste due to the implementation of clustering algorithm in each round 2. lack of attention to balancing of clusters
GLBCA	1. Run algorithm in exponential time 2. In energy consumption balance sensors 3. Balance the load on the cluster head nodes	1. Scalability Low 2. Use the focused approach and being aware of each node of the network topology
Centralized routing based on genetics	Routing schedules in less time	Fixed nodes and lack of attention to network changes
N-LEACH	Load balances traffic between cluster heads	1. Lack of Scalability 2. Lack of stability against errors occurring in the network
LEACH-ER	1. The low number of messages sent between cluster head and cluster members 2. The use of differentiated approach in services to enhance network reliability	1. Imbalances in the load flow of traffic between cluster heads 2. Scalability low, low convergence time, stability Low 3. The lack of robustness against error
A-LEACH	1. Reduce the possibility of error nodes 2. Reduce the possibility of failure cluster head node	1. The lack of Scalability 2. The lack of robustness against error
LACA	1. Distributed algorithm and independent of network size 2. No need to perform clustering in the next period	Fixed nodes and lack of attention to network changes
MIMETIC	High scalability and the ability to solve complex optimization problems and big	Fixed nodes and identify the status and network conditions
GAR	Balance in energy consumption Sensors	1. Do not use clustering with routing nodes 2. Lack of attention to the residual energy of each node at a time

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13. PSO Routing Algorithm

Particle swarm optimization algorithm first time by James Kennedy and Russell Eberhart was presented in 1995.

PSO algorithm, with having a population (which handles is called) of candidate responses (also is called particle) works. So, a problem with having a population of candidate solutions, preferably particles similar optimizes and particles into a search space by simple mathematical formulas to calculate the position and particle speed moves. The movement of each particle under the influence local best position is known while towards the best known positions in the search space (that by finding better positions are updated by particles) are guided. So particle movements with best position found by the particle in the search space and also the best position found directed by general category. That's mean when that better positions are detected, category movements directed towards better position and this process cause category towards best possible solutions is moving. By repeating this process can had hoped (but not guaranteed) that eventually, an appropriate solution be discovered. So, particle swarm optimization algorithm (PSO), is a computational method that the problem with repeated attempts to improve a candidate solution according to the considered quality standard optimizes. PSO algorithm somehow simulation of social behavior move the symbiosis organisms is in category birds or fish [15].

Unlike evolutionary algorithms in PSO there is no selection operation. That means none of particles (response) will not be deleted and only the amount of each particle changes. PSO does not use the principle of survival of generations. Solutions the combined action (Cross Over) In PSO does not exist. In PSO also somehow is practice jumps (Mutation). Because every particle in every step, position that the best results in its keeps (the best individual position of each particle) and particles in the group of particles are cooperated with each other. Particles, information about the location that where are interchange together.

The move each particles depends on three factors:

1) The current position of the particle.
2) The best position that hitherto had particle. (Pbest).
3) The best situation that hitherto had whole bunch of particles (Gbest).

The new position of each particle is achieved from the following equation:

$$New\ Position = Previous\ Position + New\ Speead \quad (10)$$

In this algorithm, speed in the current round that's mean the new speed, specifies change amount position of the particle that this expression such will be counted:

- Current Movement

$$\text{New speed} = C0 * \text{Previous speed} \quad (11)$$

- Particle memory effect

$$+C1 * \text{Rand}() * (\text{Pbest} - \text{Previous position}) \quad (12)$$

- Effect of Particles Group

$$+C2 * \text{Rand}() * (\text{Gbest} - \text{Previous position}) \quad (13)$$

Function Rand () random number generator in the interval [0,1] and C1 and C2 "constant effect" or learning factors (perceptual and social) are called. Many parameters are involved in the implementation of the PSO algorithm that appropriate adjustments them performance of the algorithm strongly under the influence puts. These parameters are as follows:

Number of particles: it has been shown that 10-20 is usually sufficient. (Each particle number of candidates for cluster centers (CH) shows.)

C1: parameter related to the best status of each Particle. (Perceptual learning factor)
C2: parameter related to the best status of neighborhoods. (Social learning factor)

Usually is maximum of C1 + C2 = 4, that only is selected experimental. The maximum amount of speed can't be too low because it cause slowdown implementation speed of the program and not much because it causes instability in the network.

PSO has many advantages over other optimization algorithms. Including:

- A method is zero level and need not have the heavy mathematical operations as making gradient.
- This algorithm is a method based on population. (Using of distributed computing)
- Computational load is acceptable.
- Convergence is relatively fast.
- PSO neighborhood topology is of star type, because we will have a faster publish.
- The main advantage of PSO: implementation is simple and able is to optimize complex cost functions with many local minima.

PSO and possible search algorithms has three major drawbacks are:

- The first problem may categories timely not converge means not move the coordinated together. (Despite the superiority of PSO on other evolutionary algorithms in terms of speed, the algorithm can't is improve solutions quality that increases number of repeated because can't use Selection operation of evolutionary algorithms and none of the particles will not be removed.)
- The second problem, being dependent algorithm is implemented. This dependence usually is thus setting the parameters of each algorithm. Therefore, with the various parameters settings for each algorithm, different execution results can be achieved.
- The third problem, PSO requires a lot of memory that may even run its implementation for base station rich in resources, gets faced with a lack of resources.

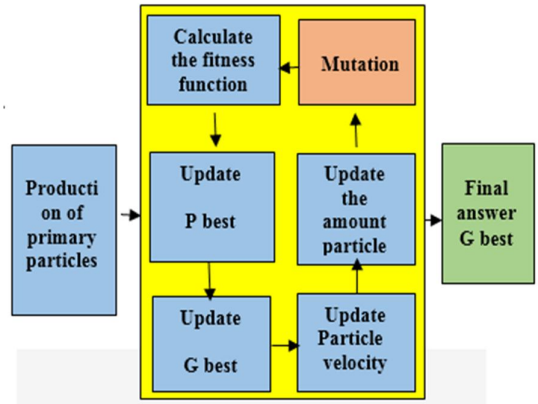

Figure 3. Performance of Particle Swarm Algorithm [14-15]

In routing algorithm based on effecting clustering in energy inspired by meta-heuristic algorithm PSO [14], in addition to the CH distance from the base station, the distance members of the cluster of CH is also taken into consideration. This algorithm with the aims of reduce energy consumption and increase the lifetime of the network is provided.

In this algorithm, in addition to the wireless sensors, number of nodes around the base station is assumed. The nodes, are called relay gates. The nodes task, receive and send data received from the sensor to the base station are responsible. The algorithm using clustering techniques, in addition to increasing lifetime, also has prevents from creation of redundancy in data transmission.

In this algorithm, each sensor information received from the environment sends only the gateway sends your cluster head gateway. CH gateway as well as information received from the sensors using the central gates to the base station sends. However this algorithm has significant efficacy compared to the previous routing algorithms based on network lifetime and energy consumption, however, in this algorithm there is still the problem of hot spots, we know that the networks where there are in it hot spots, suffer from the problem of energy holes that this problem causes a loss of energy.

To resolve this issue imbalanced clustering techniques can be used. In imbalanced clustering techniques, in first each gate your radio transmission radius calculated based on its distance from the base station. Whatever the distance of CH gateway of base stations is less, radio radius, the number of cluster members and cluster size is reduced so with this technique, can energy holes problem in routing algorithms being discussed reduced or eliminated. Also to improve clustering can be a new meta-heuristic algorithm named ALO [16], can be used. Meta-heuristic ALO algorithm from interactions among ant lion and ants in hunt is inspired. This algorithm such as Genetic Algorithm, an algorithm based on population. So at each stage of the implementation of the algorithm obtains a set of candidate answer. Elitism, an important feature of evolutionary algorithms that allow them to work hard to maintain the best answer.

14. Conclusion

ALO algorithm all the advantages of particle swarm algorithm is capable, so evaluation in 19 standard functions (F1-F19) [16] shows that ALO algorithm is higher performance than of particles swarm algorithms groups [17], genetics [18], states of matter Search [20-19], bat [21], Flower Pollination [22], Cuckoo Search [24-23] and Firefly [26-25]. So to consider this new meta-heuristic algorithms in sensor networks with having high-performance, cause improved clustering techniques on the network and also is a significant impact in reducing energy consumption in network.

Finally, for removing defects prior routing algorithms and upgrade them can be used ideas that is guaranteed with these ideas and according to the studies, energy consumption in the network will go down and network lifetime will increase.

The first idea, to consider parameters distance members of the cluster of CH and the reliability parameter that in order increases lifetime Network and scalability. The second idea, using The ALO new algorithm to demonstrate its ability to implement optimization algorithms.

The third idea, the use of imbalanced clustering techniques for improve remarkable lifetime and making a rebalance in energy consumption in the case of may the base station outside the network. The fourth idea, taking into account the sink mobile periodically in order to balance the energy consumption is at the gates of CH that according to energy consumption of CH gates in each round is determined.

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