



A Method for Reducing Wireless Sensor Network Nodes Using Genetic Algorithm and Dempster Shafer

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Abstract

In recent years, the use of wireless sensor networks in various sectors is rapidly expanding. In direct transmission, each sensor sends information directly to the center. Due to the large distance, sensors from the center consume a lot of energy. Designs that shorten communication intervals can lengthen network lifetimes. Therefore, optimal layout and power consumption directly affect the lifetime of the sensor network. In contrast to designs that shorten communication intervals, they can extend the life of the network. Therefore, optimal layout and power consumption directly affect the lifetime of the sensor network. Congestion control is defined as one of the most important challenges in wireless sensor networks. Limitations and problems that cause this first of all, there is the essence of sensor networks, and secondly, the transmission of multimedia information and applications that use this information are causing congestion. For this purpose, it is necessary to analyze the layers of this network properly and introduce the appropriate mechanisms for transmitting multimedia information in the sensor network for each layer. One of these layers is the transfer layer. Shift detection is essential to efficiently utilize network resources to balance traffic loads. In this research, a method for routing with knowledge of congestion control and interference in wireless sensor networks has been presented. In the proposed method, the congestion control scheme using the genetic algorithm and the definition of the two target functions reduced the latency of packet forwarding and the expected transfer number for reaching the destination. The simulation results indicate that the algorithm's response the suggestion can be close to the optimal answer.

Key Words

Routing Improvement, Wireless Sensor, Genetics, and Objective Functions.

I. INTRODUCTION

In a wireless sensor network, a great deal of demand for real-time services has created many challenges for service quality. The design of route routing protocols that can deliver multi-threaded goals is hardly and confusingly computable. K-connectivity-based topology control can handle multicast wireless networks. Existing algorithms focus on maintaining a k-connectivity connection between the two nodes. However, in executing network operations, k-connectivity kernel execution algorithms reduce network performance and, on the other hand, topology requires an error and interference [1].

Multi-objective optimization issues that have conflicting goal-objective functions make it possible to generate a set of answers, instead of producing an answer number. And in this way, none of the answers can be better than the other one, and all the answers are the same in this regard. One of the main goals for multithreading optimization is to obtain a set of optimally distributed replies. Retaining the diversity of numbers not only requires a certain distance between them, but also requires a good unity between sets that are not dominated. Multi-goal algorithms are used to solve these issues; these algorithms are defined in the form of algorithms whose purpose is to provide a set of optimal solutions. Then, the final solution is found by choosing the best solution available from existing solutions [3]. In many of the ways presented so far, the problem of topology control has been associated with the problem of error tolerance. For example, in [1] and [2], using error tolerance, a first method for controlling a topology is presented and then a method is proposed to delay transmission at time. By modifying the structure of this algorithm, it can also be applied to interference.

In wireless sensor networks, the phenomenon of congestion is one of the challenges in these networks. In this research, we present a way to overcome the above challenge and congestion control. In wireless sensor networks, the early detection of congestion is crucial for efficient utilization of network resources to balance traffic loads. Which is proposed in the Hedging Discovery process based on the monitoring of the status of the sensor node and the wireless channel, so that the nodes examine data traffic, energy consumption and congestion status, along with the status of congestion. The sensor node and the relationship between the nodes are monitored according to the buffer occupancy and channel use, respectively. In this study, the minimization of errors and simultaneously on minimizing the transmission latency rate using a two-objective genetic algorithm are employed.

In this research, using two-objective genetic optimization algorithm, better conditions for controlling the topology with regard to traffic congestion and load balancing in wireless sensor networks will be presented in comparison with the previous algorithms. Innovations in the proposed method the use of two load functionality and load traffic equilibrium functions are consistent in choosing a topology that has not been used so far and by defining these constraints, the data packets produced by the nodes are capable of arriving. They will have the destination node. In other words, the optimal and most suitable topology is that it has the lowest amount of congestion and traffic load balance.

II. RELATED WORKS

A routing algorithm was proposed by Alotaibi et al. In this method, the Intra-program scheduling model was used to maximize transmitted traffic to a successful destination from all sources to destination destinations. This method has created an upgrade of 58 percent compared to the previous methods, but shows an overlap in the dynamic environment [1].

Camelo presented an optimization algorithm for WMN networks using the NSGA-2 algorithm, which has three goals: minimizing packet loss, end-to-end latency, and power consumption. The NSGA-2 algorithm finds multiple paths that eliminate the needs of QOS and also support multimedia data transmission. However, this method, the resource constraints of the nodes and the non-workload balancing between nodes makes the categorized sensor networks vulnerable to communication errors and defects and reduces network reliability [2].

In his article, Zahngo et al. examined the problem of broadcast scheduling in wireless networks, which focuses on packet delays. This was done with the goal of minimizing the number of packages. In this paper, a closed-loop encoding algorithm was developed based on the maximum bandwidth of the packet, which receives all encrypted packet receiving buffers and packet decoding in the receiver algorithm. This innovative algorithm works according to the color mark on the weighted graph vertex. The simulation results show that the computational time algorithm is significantly reduced but does not cover the error tolerance [8].

Wilder et al. provided a new error-aware routing protocol and quality-assured service. This ensures delays, vibration and reliability in wireless multimedia sensor networks. In this protocol, each sensor node knows the location of the neighboring nodes and wells and uses this information in routing. By trying to reduce the number of steps it closes to the destination, it attempts to reduce latency to the end of packets. The reliability of this protocol is guaranteed by simultaneously sending two copies of the packet to the well. Vibration is an important parameter for multimedia streams in real time; this parameter must be considered by the routing protocol in order to avoid misunderstandings and errors in the information received at the destination. The simulation results prove that the protocol is efficient in ensuring latency, vibration and reliability, and efficiently in terms of energy consumption, in a multimedia sensor network, but cannot simultaneously improve These parameters reduce the level of interference [6].

Hague et al presented an error-aware topology in a case network. These land-based land-use protocols are designed to be safe to receive delays with sensitive delays, while high vehicle dynamics and internal network segmentation are considered to be frequent, which is still not achievable in articles. The advantage of the protocol is to better utilize the network throughput by avoiding the unnecessary exchange of information between vehicles. The application protocol can be easily accessed; in this way it is possible to increase the interference in higher latencies and static state of the network [4].

Luo et al proposed a destination-aware and dense and adaptive protocol. Each node finds more than one path between itself and the destination. Each intermediate node sends packets according to path conditions. If a busy path is detected, a warning packet will be sent to the source to redirect towards the path with less load. If all nodes perform the same routing strategy

in the case-vehicle case, the overall load of the network is balanced and balanced across all connected paths. The proposed proposal has the minimum traffic on the network and has the best performance in high-traffic loadings [5].

Fukunaga et al In order to reduce the complexity of the route planning plans, a decentralized route planning algorithm has been proposed based on a hierarchical routing scheme. It is a matter of route planning, route selection, and intra-regional routing. In selecting the area paths, the average transit time of the areas is minimized so that areas under intense conditions can be effectively induced. In intra-regional path planning, the optimization model aims to minimize the average time of intra-regional traffic. The advantage of the proposed algorithm, its low complexity, and its weakness is greater interference in the network [3].

Xu et al proposed a new routing protocol for inter-car-related case networks in urban scenarios. The Stable CDS-based Routing Protocol protocols to extract general topology information to increase and improve the quality of service at low-level non-safety applications for modulating network congestion. This protocol grows to find the most sustainable paths between source and destination. The SCRPP protocol begins by constructing a solid framework on the road sections and connecting them through nodes as bridges at intersections. Then, these weights are assigned to different parts of the road based on the data collected through Road Assessment Packet; this method does not cover interference in paths created in static mode [7].

III. CONGESTION CONTROL USING GENETIC ALGORITHM

The genetic algorithm has a number of parameters that have a particular problem and should be checked and adjusted to obtain the best performance of the algorithm. These parameters are the size of the population, which is the probability of intersection and jump, and the type of intersection. The genetic algorithm involves random operations during the optimization process, while the initial quality of the random population generated significantly affects the final performance.

Genetic algorithm is a special type of evolutionary algorithm that uses biological methods such as inheritance and mutation. In a genetic algorithm, a chromosome is a set of indices, which defines a proposed solution for the problem that the genetic algorithm tries to solve.

The genetic algorithm starts with the production of a random primitive population. After initial population production, a percentage of chromosomes are randomly selected as the parent of the current population. Wald's chromosomes are combined and create two children's chromosomes through the exchange of information. Also, the mutants can also be used to make children more efficient. After this stage, the new generation is evaluated using the fit function. A new generation is being produced from the population of the best children and the population of the old generation.

In Fig. 1, the genetic algorithm used in the proposed method is presented. Primary population is delivered as a preliminary random solution to the genetic algorithm for the start of work. Each chromosome is a kind of indication of how to connect sensor nodes to clusters. The length of each chromosome is equal to the number of sensor nodes in the current stage.

For example, if i -th gene of a second-order chromosome is j , then the node is assigned to the cluster header gj . For each sensor node, an exclusive number (beginning of 1) is considered as the identification number. Therefore, in the chromosome of the answer, the index of each gene refers to the number one sensor node. The value of each gene is also referenced to the node number for the sensor node. The gene value that represents the cluster head node is equal to the gene index.

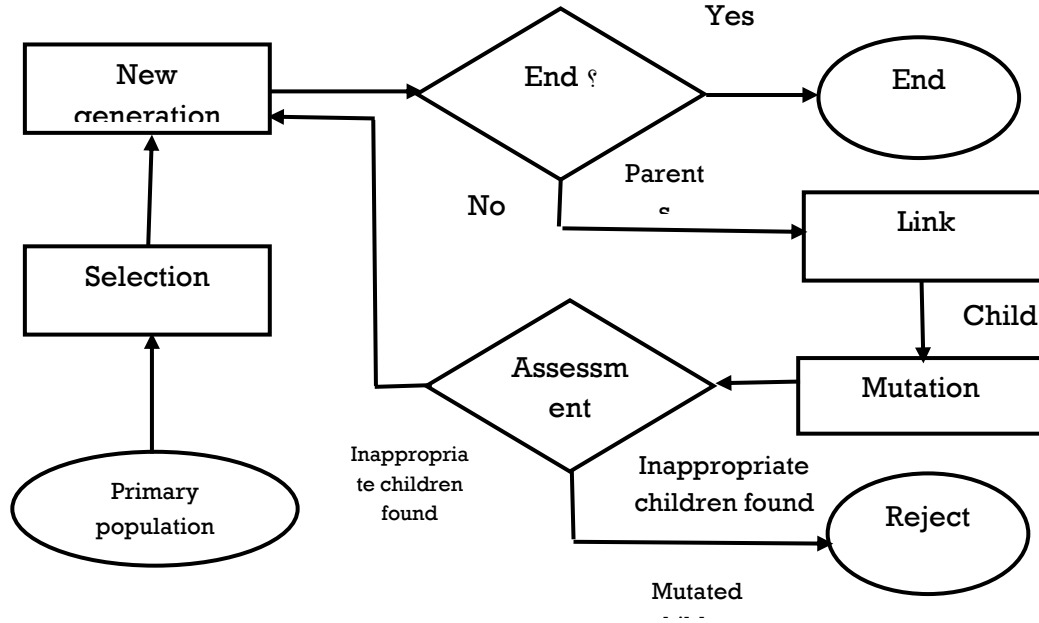


FIGURE 1: FLOWCHART GENETIC ALGORITHM

IV. PROPOSED METHOD

The conventional method for displaying chromosomes in a genetic algorithm is to use a binary string. Each variable is displayed binary and then the chromosome is created by adjoining the variables. In the proper function, a value is considered for each code. During the process, parents will be eligible to born by combining gene mutations with new offspring. This process repeats several times to create the next generation. Then this population is examined and if the convergence criteria are met, the process ends.

The pseudocode of the proposed method is shown in Fig. 2. In a multi-objective problem, different approaches to elitism can be considered. In one approach, only one response, as the best chromosome of each generation, can be transmitted to the next generation, which practically does

not have much opportunity to combine with other chromosomes and produce various responses. Another approach could transfer all of the top-notch responses to the next generation, which would also reduce the number of new responses that are being generated in the evolution process, and in practice, the process of achieving optimal responses Slow down An appropriate approach is the procedure between these two, which results in the transfer of superior chromosomes α to the next generation. The parameter α represents the selection pressure of the elite operator.

1. Set $t = 0$, $N = \text{Population Size}$.
2. Select ETX and MD values from OLSR routing table.
3. Generate initial population routes using priority based encoding.
4. P_t = Calculate the objective functions for the initial population.
5. Repeat.
6. Q_t = Generate offspring from P_t according to recombination and mutation operator.
7. $R_t = Q_t \cup P_t$.
8. F = Do Fast non dominated Sorting (R_t), Obtaining different non dominated fronts ($F_1, F_2, \dots, F_n$).
9. Dynamic crowding distance assignment (F_i).
10. Apply the selection of routes based on the binary tournament selection.
11. $t = t + 1$.
12. Until $t < \text{MaxGen}$

FIGURE 2: PSEUDO CODE THE PROPOSED METHOD

In this research the genetic algorithm is performed in the proposed method with two methods of mutation and integration.

V. SIMULATIONS AND COMPARISON OF THE PROPOSED METHOD

Matlab software is used to simulate and evaluate the proposed algorithm. Given the fact that the proposed method uses a revelation algorithm, the convergence of the results is evaluated, which will be presented below.

To test the convergence, the proposed method, as well as the genetic algorithm for three paths consisting of 5, 10 and 20, were executed and Figures 3, 4 and 5 respectively show the convergence method to the final answer, respectively. In the graphs, the horizontal axis of repetition of the algorithm and the vertical axis is also the best fit for each repetition.

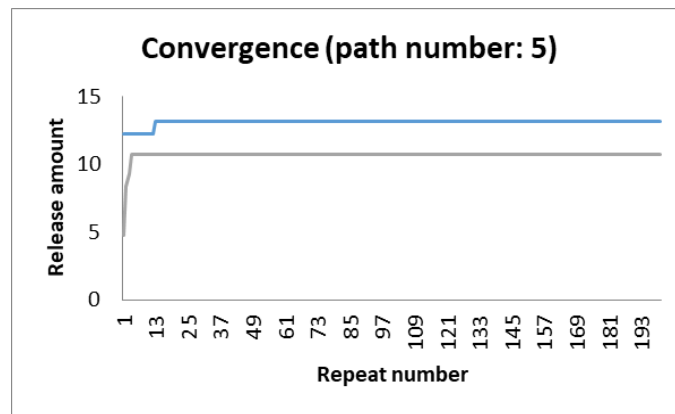


FIGURE 3. CONVERGENCE OF PROPOSED ALGORITHM (PATH NUMBER:5)

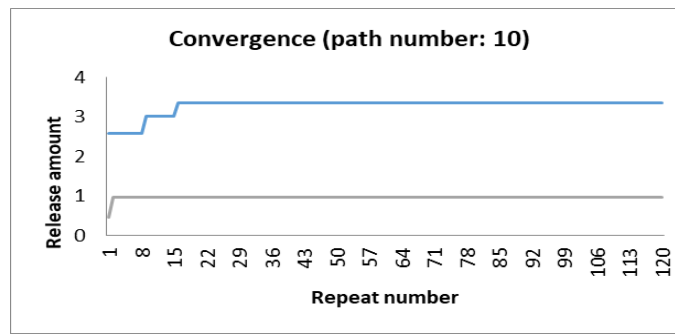


FIGURE 4. CONVERGENCE OF PROPOSED ALGORITHM (PATH NUMBER:10)

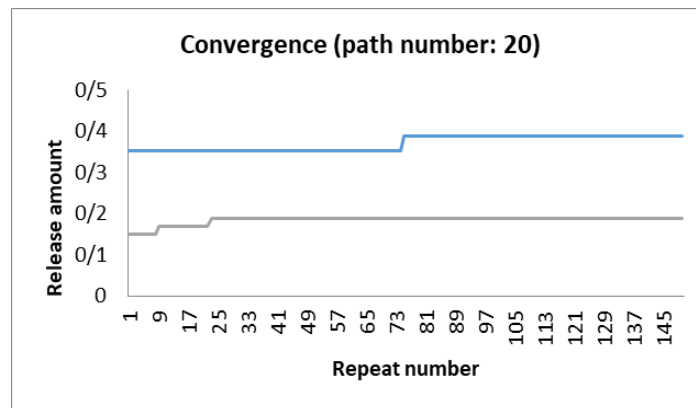


FIGURE 5. CONVERGENCE OF PROPOSED ALGORITHM (PATH NUMBER: 20)

By examining the results of this experiment, it is determined that the proposed method for combining the paths of the sensor networks has a good degree of convergence and finds a near optimal path. Also, the results show that the composite path quality created by the proposed method is better than the basic genetic algorithm.

To solve the problem of optimal node placement in sensor networks, evolutionary algorithms such as genetic algorithms and other algorithms can be used. Modeling and implementation of the problem and the improvement of the genetic algorithm using the exchange and inverse operators in the mutation and the quantitative and qualitative results of the use of evolutionary algorithms were presented. The results indicate that the improved genetic algorithm has the best performance against the other algorithms, and the weakest function belongs to the artificial beehive algorithm. Particle swarm optimization algorithm performs better than genetic algorithms and bee venom, but compared to the improved genetic algorithm, its performance is weak. Therefore, the improved genetic algorithm is chosen as the best algorithm to solve the problem of optimal node arrangement in the sensor network to reduce the power consumption of the network through the optimal connection of the nodes to the nodes of the well.

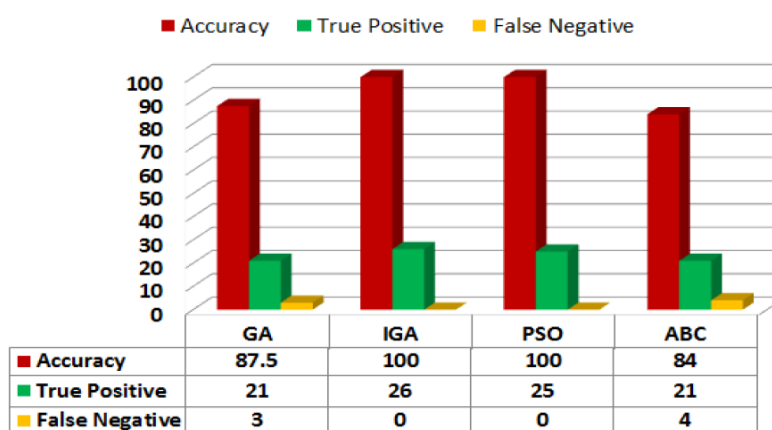


FIGURE 6. THE ACCURACY VALUE IN ASSIGNING NODES TO WELLS FOR DIFFERENT EVOLUTIONARY ALGORITHMS

The main reason for this experiment is to compare the quality of the paths created by the proposed method and the two-objective genetic algorithm. To conduct this experiment, 20 different applications with 5, 10, and 20 routes have been run for the above methods, and the average operational capability obtained from their implementation is presented in Table 1. With care in the results of Table 2, it can be seen that the quality of the paths produced by the proposed method of a two-objective genetic algorithm is better with respect to the path quality criteria.

TABLE (1) PERFORMANCE OF TWO GENETIC ALGORITHMS

GA	MNSGA-2	Number of nodes
0.5	0.3	20
0.8	0.7	40
0.9	0.8	60
1.7	1.5	80

TABLE 2. COMPARISON OF THE QUALITY OF PRODUCED COMPOSITE PATHS

<i>Method</i>	n = 5	n = 10	n = 20
<i>Dual-Objective Genetic Algorithm</i>	10.98562	1.67522	0.28952
<i>Suggested Method</i>	15.68594	4.89854	0.42658

Given the characteristics of evolutionary algorithms, obviously seems to be the advantage of multi-objective systems. In other words, due to the intrinsic nature of the evolutionary algorithms, it is possible to achieve optimal solutions by utilizing various goals and designing a multi-objective, covering the fuller space of the problem.

VI. CONCLUSION

In this research, a new framework for routing with knowledge of congestion control and interference in wireless sensor networks was presented. The proposed method was to find an optimal combination that is well suited. Also, the proposed algorithm was implemented with main source parameters and related graphs were observed. Using a two-objective genetic algorithm reduces the amount of time needed for routing, although it does not give us the definitive answer and will give us near optimal answer. To illustrate the performance of each algorithm, it is necessary to compare it with previous algorithms. Therefore, the results of the work were compared with two-objective genetic algorithm. By comparing the two algorithms, we conclude that the response time of the two-objective genetic algorithm is lower than that of the basic genetic algorithm, and also with respect to the convergence diagrams, for a two-objective genetic algorithm, for a given number of paths, So the convergence of the two-objective genetic

algorithm is good and it can be concluded that the solution obtained from the proposed algorithm is close to the optimal answer.

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