

Minimization of Energy Consumption using modified BFO Algorithm in Wireless Sensor Network (WSN)

Soham Walke, Gaurav Bhosale, Somesh Pawar, Sachin G. Shelke, Prof. Mr. Pramod D. Ganjewar

Department of Computer Engineering, MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Department of Computer Engineering, MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Department of Computer Engineering, MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Department of Computer Engineering, MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Department of Computer Engineering, MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

ABSTRACT: The popularity of Wireless Sensor Networks (WSN) have increased rapidly and tremendously due to the vast potential of the sensor networks to connect the physical world with the virtual world. Since sensor devices rely on battery power and node energy and may be placed in hostile environments, so replacing them becomes a difficult task. Thus, improving the energy of these networks i.e. network lifetime becomes important. The thesis provides methods for clustering and cluster head selection to WSN to improve energy efficiency using fuzzy logic controller. It presents a comparison between the different methods on the basis of the network lifetime. It compares existing ABC optimization method with BFO algorithm for different size of networks and different scenario. It provides cluster head selection method with good performance and reduced computational complexity. In addition, it also proposes BFO as an algorithm for clustering of WSN which would result in improved performance with faster convergence.

KEYWORDS: Wireless sensor network, BFO Algorithm.

I. INTRODUCTION

By improvement in processors and wireless communication technologies, wireless sensor networks (WSNs) in the upcoming days will be used everywhere. WSNs consist of many sensors which usually diffuse in an unavailable area and after collecting data and doing some primary process in that region they will send them to the base station. Sensor networks are used in different fields, like: military areas, medical access, environmental activities and household d quest

. But, in all these fields, energy has a determining role in the staging of WSNs. Consequently, data routing methods and the way of transferring them to the base station are very important. This is because sensor nodes usually use battery power; therefore, sensor's energy is limited. To sum up, a new routing method with Optimum consumption of energy and selecting the shortest path for data transfer in WSNs is desired. [1]

Clustering is widely adopted in WSNs, wherever the whole network is split into multiple clusters. Clusters have cluster heads (CHs) be answerable for information aggregation. It has the ease of use of low energy, routing is easy and sensitive quantifiability, and it cut back the energy hole downside to some extent. Cluster head is a node which is responsible for maintain cluster, collect data from nodes in the cluster and communicating with sink. By using clustering methodology, it has been observed that there is large amount of energy that has been saved. In static clustering method some rules were followed to elect a cluster head, once a cluster is made and cluster head is chosen,

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the cluster was inactively operated until the head node dead. Because cluster head node has more responsibility so rapid decrease in energy in the Cluster head node. The end time was head node was too soon in static clustering technique. [2].

A number of protocols play an important role to reduce energy utilization. Direct communication and multi-hop data transmission used at the beginning. But due to determined power of sensor nodes these techniques don't work effectively. Energy is very critical issue in WSN, because of limited energy in sensor nodes, so to preserve energy clustering technique was introduced; in which out of thousands of nodes few nodes become cluster head and they manage the entire network.

Bacterial Foraging Optimization (BFO) is a recently developed nature inspired optimization algorithm, which is depend on the foraging behavior. Bacterial Foraging Optimization (BFO) algorithm has been developed to model the bacterial foraging behavior for solving optimization problems. Recently, the BFO algorithm has been applied successfully to some engineering problems [3]

II. RELATED WORK

proposed a new algorithm Bacteria Foraging Algorithm (BFA) along with the transformer taps are tuned with a view to simultaneously optimize the actual power losses and voltage stability limit. Kelvin M. Passino et al has proposed to improve the energy efficiency of the control system using Bacteria Foraging Algorithm (BFA). Thus, extending the life-time of the control system Indrajit Banerjee et al has proposed to maximize the lifetime of sensor nodes and also to find the shortest path between cluster head and base station for effective data transmission to base station. Lijiang Goo, Beijing et al has proposed to improve node energy efficiency, balances energy consumption of all sensor nodes, enhances the reliability of data transmission and increases the network lifetime in comparison to LEACH. proposed energy conservation techniques and algorithms for calculating energy-efficient topologies for WSNs. The energy efficient method of introducing a coordinator to a WSN is presented. They showed that algorithm outperforms the results obtained for popular clustering based power save protocol GAF. Liu Yueyang proposed a new chaining algorithm EBPEGASIS, which uses distance threshold to avoid this phenomenon in PEGASIS. Using this algorithm, the sensor networks can achieve energy balance.

In this author proposed methods for clustering and cluster head selection to WSN to improve energy efficiency. The modified approach for cluster head selection with good performance and reduced computational complexity. They presented a comparison between the different methods on the basis of the network lifetime. In addition, it also proposes BFO as an algorithm for clustering of WSN which would result in improved performance with faster convergence.

III. BACTERIA FORAGING OPTIMIZATION

The swarm intelligence methods are promising solutions to these challenging optimization problems. Dealing with the constrained optimization problems using the Evolutionary Algorithms (EA), such as Particle Swarm Optimization (PSO), Artificial Immune Systems (AIS), Harmony Search (HS) and other meta-heuristics methods, has also attracted great interest during the recent years. The Bacterial Foraging Optimization (BFO) is a novel biology-inspired technique developed by Passino. The Bacteria Foraging is an evolutionary algorithm which estimates cost function after each iterative step of the program as the program execution proceeds and leads to progressively better fitness (less cost function). The parameters to be optimized represent coordinates (position) of the bacteria

. The parameters are discretized in the desirable range, each set of these discrete values represent a point in the space coordinates. Then one bacteria is positioned (created) at each point. After each progressive step the bacteria move to new positions (new coordinate values) and at each position cost function is calculated and then, with this calculated value of cost function, further movement of bacteria is decided by decreasing direction of cost function. This finally leads the The foraging strategy of E. Coli. Bacteria are governed by four processes. These are chemo-taxis, swarming,

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reproduction and elimination and dispersal. Chemo-taxis is achieved by swimming and tumbling. When the bacterium meets favorable environment (rich in nutrients and noxious free), it continues swimming in the same direction. Decrease in cost function represents favorable environment, while increase in cost function represents unfavorable environment. When it meets unfavorable environment it tumbles (changes direction). In swarming, the bacteria move out from their respective places in ring of cells by bringing mean square error to the minimal value.

The main objective of WSN is to guarantee a certain network lifetime and to ensure that all the nodes in the network die at the same time, so that very little energy left behind in the network when the network expires. As nodes in the network are resource constraints because of limited battery, limited computation and communication capability because of small size processors, so to have longer lifetime there is a need of energy optimization of network resources which can be achieved by doing efficient routing. Routing protocol are responsible for discovering and maintaining energy efficient routes in order to make the communication reliable and efficient. Clustering routing emphasis on keeping up the energy utilization of the sensor hubs by including them in multi-hop fashion for routing (which reduces the long distance communication) and perform data aggregation and fusion to reduce the number of messages delivered to sink hence reduces the number of transmissions. Clustering offers the advantages of scalability, fault tolerance, data aggregation load balancing, stabilized network topology, maximal network lifetime reduced routing delay, energy saving, increases system capacity, make the network robust and guarantee of connectivity. Research is going on selecting the size of the grid, fair selection of cluster head and many more for making it suitable for various applications like for large scale wireless network, for solving hot spot problem, for load balancing, energy efficiency etc. Cluster head has the responsibility of transferring the data from the entire cluster head to the base station, hence due to extensive load cluster head consumes more energy and die soon. Efficient approach for the selection of cluster head and increases the network lifetime and reliability of the network. Cluster head is selected based on the various parameters like current energy of the network, distance from the base station and node degree, also rotation of the role of cluster head among the cluster members is preferred to distribute the load among the nodes. In this paper, static grid approach for clustering and dynamic cluster head based on the closeness centrality is utilized to have energy efficiency in the network. Energy consumption is calculated by transmission distance hence it is important to choose the CHs at optimum location to minimize the energy consumption. In graph theory the term node centrality is measure of importance of node in the graph. Among different types of centralities, closeness centrality measure how fast information can spread from node to any other node in the network (i.e. based on the distance) . Different routing protocols have been designed to select a data transfer path up to the base station which is having minimum consumption of energy in order to prolong the network lifetime, reduce energy consumption and reducing the delay. Bio inspired or heuristic routing is gaining popularity as these algorithms offer an energy efficient network, by finding the optimal solution in terms of finding the best path between source to destination. Hence BFO (Bacterial Foraging Optimization) is utilized in this paper for routing purpose.

IV. ENERGY EFFICIENCY USING MODIFIED BFO IN WSN

Bacteria Foraging Algorithm in wireless sensor network is used to improve the energy efficiency of each sensor nodes, whereas in previous schemes it used in control system. Now a days Bacteria Foraging technique is gaining importance in the optimization problems. Because Philosophy says, Biology provides highly automated, robust and effective organism. Search strategy of bacteria is salutary (like common fish) in nature.

Bacteria can sense, make a decision and act so adopts social foraging (foraging in groups). To perform social foraging an animal needs communication capabilities and it gains advantages that can exploit essentially the sensing capabilities of the group, so that the group can gang-up on larger prey, persons can obtain safety from predators while in a group, and in a certain sense the group can forage a kind of intelligence. BFO is based on the foraging performance of Escherichia Coli (E. coli) bacteria present in the person intestine.

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In this scheme base station moves towards that cluster head which have highest priority. During the movement towards cluster head of highest priority base station follows only predefined circular path. In this scheme triangular shaped membership function has been used. Therefore, fuzzy logic is an important tool for decision making in this case.

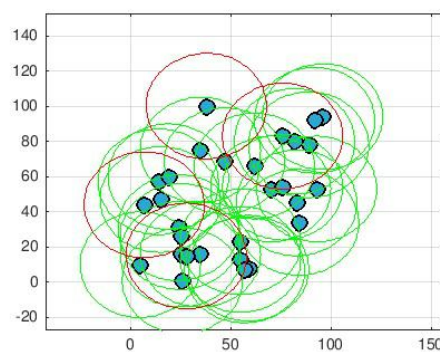


Fig. WSN network

V. CONCLUSION

We have proposed a unique strategy for the motion of base station using fuzzy logic and this approach has been successful in prolonging the lifetime by a significant amount as compare to stationary base station case. Simulation results shows that wireless sensor network having base station moving on circular path gives more lifetime than that of stationary base station case.

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