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A Review on Energy Efficiency in WSN Using BFOA

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Abstract: ***Wireless Sensor Networks (WSN) has increased tremendously in recent time due to growth in Micro-Electro-Mechanical Systems (MEMS) technology. WSN has the potentiality to connect the physical world with the virtual world by forming a network of sensor nodes. Here, sensor nodes are usually battery-operated devices, and hence energy saving of sensor nodes is a major design issue. Energy control is the most important problem for wireless sensor networks, and the design of an efficient energy strategy for prolonging the whole networks lifetime. Bacterial foraging optimization algorithm (BFOA) has attracted a lot of attention as a high performance optimizer because of its faster convergence and global search approach. Since its inception in 2001, many variants of BFOA have come up leading to even faster convergence with higher accuracy. The focus of this paper is to present the energy control strategy in energy-efficient routing protocols for wireless sensor networks using BFO.***

Keywords: BFOA, Bacteria Foraging Algorithm, PSO

1. Introduction

Wireless Sensor Networks(WSN) have gained world-wide attention in recent years due to the advances made in wireless communication, information technologies and electronics field [1, 2, 3, 4, 5].The concept of wireless sensor networks is based on a simple equation: Sensing + CPU + Radio = Thousands of potential applications [6] . It is a sensing technology where tiny, autonomous and compact devices called sensor nodes or motes deployed in a remote area to detect phenomena, collect and process data and transmit sensed information to users. The development of low-cost, low-power, a multifunctional sensor has received increasing attention from various industries. Sensor nodes or motes in WSNs are small sized and are capable of sensing, gathering and processing data while communicating with other connected nodes in the network, via radio frequency (RF) channel.

The characteristics of WSN are dynamic topology, bandwidth, energy, security, distributed operation, light weight terminal and self oriented [8]. Due to the node mobility, the topology of wireless sensor networks changes continuously and unpredictably. WSNs have significantly lower bandwidth capacity in comparison with fixed networks. There is no background network for the central control of the network operations, the control and management of the network is distributed among the terminals. WSNs nodes are mobile devices with less CPU processing capability, small memory size and low power storage [8]. A wireless sensor a network includes several advantages over traditional wireless networks, including: ease of deployment, speed of deployment and decreased dependence on a fixed infrastructure [8].

WSN may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, and acoustic and radar. They are able to monitor a wide variety of ambient conditions that include temperature, humidity, vehicular movement, lightning condition, pressure, soil makeup, noise levels, the presence or absence of certain kinds of objects, mechanical stress levels on attached objects, and the current characteristics such as speed, direction and size of an object[7]. WSN applications can be classified in to two categories: Monitoring and tracking. Monitoring applications include indoor/outdoor environmental monitoring, health and wellness monitoring, power monitoring, inventory location monitoring, factory and process automation, and seismic and structural monitoring. Tracking applications include tracking objects, animals, humans, and vehicles and categorize the applications into military, environment, health, home and other commercial areas. It is possible to expand this classification with more categories such as space exploration, chemical processing and disaster relief.

2. 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 [17]. 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 bacteria to a position (set of optimization parameters) with highest fitness.

The foraging strategy of E. Coli. Bacteria are governed by four processes. These are chemo-taxis, swarming, 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.

3. Energy Efficiency in WSN

Energy control is the most important problem for wireless sensor networks, and the design of an efficient energy strategy for prolonging the whole networks lifetime. The focus is the energy control strategy in energy-efficient routing protocols for wireless sensor networks. Considering the issues packet delivery fraction, End to end delay and Energy consumption Performance, Packet delivery fraction is the ratio of the data packets delivered to the destinations to those generated by the sources. End to end delay is the total latency experienced by a packet to traverse the network from the source to the destination. Energy consumption is the total number of energy consumed for packets transmitted and packets receiving during the simulation. Energy consumption is the total number of energy consumed for packets transmitted and packets receiving during the simulation [18].

In the network layer, the choosing of routing relates to the node energy consumption while transmitting data. There are a few paths between two nodes, and of course different routing consumes different energy. We can choose the route which consumes the last energy or the route on which the nodes provides the most energy. The energy consumption in Wireless Sensor Networks (WSNs) occurs in three domains: - sensing, communication and data processing. When sensing message, the sensors consume the energy. How to save the energy is due to the mode of sensing messages, while the physical energy consumption is fixed. Communication is the major consumer of energy. The relation between energy consumption and communication range in wireless sensor networks is

E=Kd

Where,

- E is the energy consumption
- d is the communication range, and 2<n<4
- K is a constant

From the formula, the longer range is, the more the consumption .And the data processing also consumes energy. For the scalability of energy consumption in WSN, all the components of the sensor node are supposed to be controlled by an operation system, such as micro Operating System (µOS) [9]. Thereby, shutting down or turning on any component is enabled by device drivers in the specified WSN application.

4. Energy Efficiency Using 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 day's Bacteria Foraging technique is gaining importance in the optimization problems [10]. 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.

5. Related Work

M. Tripathy et al has 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 [11] 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 [12] 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. Lejiang Guo, Weijiang 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.

Author [13] 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 [14] proposed a new chaining algorithm EB-PEGASIS, which uses distance threshold to avoid this phenomenon in PEGASIS. Using this algorithm, the sensor networks can achieve energy balance and prolong network lifetime.

In this author [15] 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.

6. Conclusion

WSN has the potentiality to join the physical world with the virtual world by creating a network of sensor nodes.

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