SGO A New Approach for Energy Efficient Clustering in WSN

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ABSTRACT

In wireless sensor networks (WSNs), consumption of energy is the major challenging issue. If the data is transmitted directly from the node to the base station, it leads to more transmissions and energy consumed also increases if the communication distance is longer. In such cases, to reduce the longer communication distances and to reduce the number of transmissions, a clustering technique is employed. Another way to reduce the energy consumed is to reduce the transmission from node to CH or from CH to BS. Reducing the transmission distance is a NP-Hard problem. So, optimization techniques can be used effectively to solve such problems. In this article, is the implementation of a social group optimization (SGO) to reduce the transmission distance and to allow the nodes to consume less energy. The performance of SGO is compared with GA and PSO and the results show that SGO outperforms in terms of fitness and energy.

KEYWORDS

Base Station, Cluster Head, Clustering, Energy Consumption, Node, Optimization, Sensor

1. INTRODUCTION

Wireless sensor networks (WSNs) have become a powerful technological platform with novel applications that is driving many researches to work for applications like military surveillance, environment monitoring, health monitoring, disaster management, etc., as discussed by author Elhabyan et al. (2015). WSN consists of sensor nodes termed as nodes. The basic component of the node is the micro-sensor which helps to sense the desired event. The node also consists of battery, transmitter, receiver, microprocessor etc. in order to communicate with the network. The main function of the sensor is to sense the physical environment, gather the information from the surroundings, perform basic computation on the data and then transmit it to the base station (BS) discussed by Zangeneh et al. (2017). WSN is an event-based system that consists of low-cost, low-power sensor nodes that are used in many applications like military, civil, health monitoring, environment monitoring etc. Applications like civil and military require the location of the nodes to be known for which best localization techniques must be used as analyzed by Alaybeyoglu et al. (2015). The advancement in the sensor technology have led to the rise of the new application of human detection, tracking and activity recognition discussed by Kamal et al. (2016). For distributed applications, time consistency among the sensors is the major feature that should be addressed as explained by Shi et al. (2015).

WSN consists of thousands of sensors which are randomly deployed and are connected wireless in an ad hoc manner. Zangeneh et al. (2017) stated that these sensors communicate with each other and share the information among them based on the infrastructure and topology of the network. WSN must have the capability to make the sensors operate in harsh and unattended environments where the network is inaccessible and unscheduled. In such environments, it is not possible of replacing or
recharging the battery of the sensor if the battery dies. Thus, the energy consumption of the sensor becomes a challenging issue. The issues with the wireless sensor networks and its various applications are explained by Satapathy et al. (2016). The sensor must consume less energy for the communication especially, for longer distances in order to increase the network lifetime discussed by Akila et al. (2016).

Many approaches have been developed to reduce energy consumption of the sensor. One possible approach for consuming less energy by the nodes is to introduce the concept of sleep mode and active mode of the node. If the devices or nodes are in active state only for some moment of time, the remaining energy can be used later. This concept can also be applicable to the issue of fault tolerance along with energy consumption explained by Al-Kahtani et al. (2015). Of the many approaches, clustering technique is the best approach through which the energy can be consumed efficiently. Clustering is the technique in which the sensors are organized or grouped together to form clusters. Each cluster will be having a cluster head (CH) and it plays the role of a leader. The sensors sense the data and transmit it to the CH and the CH performs aggregation of data and broadcast it to the BS. The reasons that only clusterhead relay the data out of the cluster is to evade the collisions with the sensors present inside the cluster discussed by Elhabyan et al. (2015). The sensors can share information only within the cluster but not between the clusters.

Another challenge to the wireless sensor network is security. Many methods have been proposed for authentication and data encryption. For secure transmission of sensor data over wireless media a symmetric key cryptography with classical cellular data rule is used by Roy et al. (2016). Encryption model and its improved encrypted model is proposed be Vangala et al. (2018) for sensor data security.

The paper is categorized as follows. Section 2 explains the study of all the clustering techniques done by using optimization methods. The traditional optimization methods can also be used to find a solution, but they may not perform with the increase size of input. For flexibility and higher scalability evolutionary / nature inspired algorithms performs better. They are used to solve problems for global optimization. Section 3 describes the problem statement, SGO technique, fitness function and energy equation. Section 4 shows the simulation and results of SGO and its performance comparison. Section 5 gives the conclusion and future work.

2. LITERATURE SURVEY

Riham S. Elhabyan et al. (2015), aims to prove that the selection of cluster head plays a major role in clustering as it is responsible for gathering the data from the nodes, controlling the nodes and transmitting the data to the BS. So the node with maximum energy should be elected as a CH. Clusters must be formed in such a way that they maximize the network lifetime and utilize the energy efficiently. Three evolutionary algorithms, GA, DE, and PSO are implemented and their fitness convergence is compared.

Zangeneh et al. (2017) explain that the longer communication distances between the sensor and the BS leads to high consumption of energy. So, best approach is to cluster the network. A dynamic clustering method is proposed using Genetic Algorithm (GA) and Artificial Bee Colony (ABC) techniques. GA is used to select the cluster head dynamically and ABC approach is used to select the member nodes for the respective CH. CH is selected based on the residual energy of the node.

Akila et al. (2016) proposed an approach to eliminate the formation of the residual nodes. The remaining sensors that are not part of any of the cluster are termed as residual sensors. The residual sensors consume more energy as they sense the data and directly send it to the BS either in single hop or multi hop fashion. The residual node formation is eliminated by clustering the network in such a way that each node should be the member of at least one cluster. PSO technique is used for uniform clustering. Leaped frog algorithm is used to determine the number of clusters in the network.

Hatamian et al. (2015) propose a centralized evolutionary clustering protocol based on GA. The protocol operated in two stages. In set-up stage, the CH selection and cluster formation takes place depending on the energy status of the sensor. As the approach is centralized, the BS is responsible
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