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GSA Tuned Cluster HAED Selection for WSN Enegry Consuption Minimization

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Abstract

The popularity of Wireless Sensor Networks (WSN) has 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 GSA 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 GSA as an algorithm for clustering of WSN which would result in improved performance with faster convergence.

Keywords: Clustering head selection method; Wireless Sensor Networks; ABC; GSA

1. Introduction

1.1 Wireless Sensor Networks

Sensor nodes offer a powerful mixture of distributed sensing, computing and verbal exchange. The ever-increasing skills of those tiny sensor nodes, which include sensing, statistics processing, and speaking, allow the belief of WSNs primarily based at the collaborative attempt of a number of other sensor nodes. They allow an extensive range of programs and, at the equal time, provide numerous challenges because of their peculiarities, basically the stringent electricity constraints to which sensing nodes are generally subjected. WSNs comprise knowledge and technologies from 3 unique fields; Wireless communications, networking and Systems and Control theory.

Efficient design and implementation of wireless sensor networks has become a hot area of research in recent years, due to the vast potential of sensor networks to enable application that connect the physical world to the virtual world. By networking large numbers of tiny sensor nodes, it is possible to obtain data about physical phenomena that was difficult or impossible to obtain in more conventional ways. Potential applications for such large-scale wireless sensor networks exist in a variety of fields, including medical monitoring, environmental monitoring,

surveillance, home security, military operations, and industrial machine monitoring. Protocol design for sensor networks must account for the properties of ad hoc networks, including the following.

- Lifetime constraints imposed by the limited energy supplies of the nodes in the network.
- Unreliable communication due to the wireless medium.
- Need for self-configuration, requiring little or no human intervention.

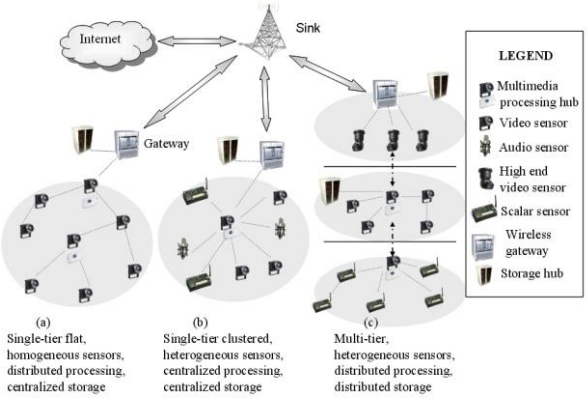

Figure 1: Wireless sensor networking

Attacks can be categorized as insider (internal) and outsider (external) Attacks can also be classified as passive and active attacks. ***Internal attacks****:* In this type of attack, nodes of the networks perform abnormally. It can destroy the entire network easily by using compromised node. ***External attacks***: In this type of attack, nodes which performed attack functions, are not belongs to the network. So, they have no information such as cryptographic of the network. ***Passive attacks:*** These attacks are outside from the network so they do not direct affect the network. ***Active attacks****:* These attacks are inside the network and disturb all the activity of the network. It also interrupts the information, modification, traffic analysis, and traffic monitoring.

We set our objectives for the dissertation work as:

- To allocate the channel and path to video data to minimise the energy consumption, the non linear programming formulation will be used. This NLP problem will be solved by more accurate optimisation algorithm.
- To reduce the power consumption only active nodes (which will be triggered at some activity detection) will be considered.
- An IOT network of 100-400 nodes will be considered and whole proposed work will be simulated in MATLAB environment.

2. Proposed Work

In our work, we implemented Gravitational search Algorithm (GSA) algorithm in a cluster-based routing protocol based on Sugeno fuzzy inference system. As in a given populations of nodes clustering can be done by different techniques such as FCM, K-means, C-means etc. We have used K means for clustering as it is efficient and fast. After clustering, centroid of cluster chosen. In the cluster-based protocols Cluster Heads (CHs) are generally selected among all sensor nodes from pool of nodes that is reliable to maintain cluster work, and then, clusters are made by assigning each node to the nearest CH. The major limitation is to generate an inappropriate distribution of CHs over WSN. The main steps of our work can be summarized as follows:

- An optimized Sugeno fuzzy inference system (FIS) is proposed as an efficient and fast, application specific routing protocol in Wireless Sensor Network environment. We have designed three membership functions with 27 set of rules in Sugeno.
- K-means algorithm is utilized to form balanced clusters over the network.
- An objective function is made to calculate residual energy (RE), distance of node from sink (DNS), distance of node from centroid (DNC). Position of centroid is calculated by K-means algorithm. Objective functions also find position of Cluster Head on the basis of fuzzy inference system.
- Gravitational Search Algorithm (GSA) algorithm is implemented to optimize the fuzzy rules of FIS file in order to prolong the network lifetime, based on the different application specifications. Flow chart of our work is given below for easy understanding.

3. Fuzzy Logic Inference System

The fuzzy logic controller for our case has three real time inputs measured by objective function for each node in a cluster. These are:

1. *Residual energy of node (RE)*
2. *Distance of node from sink of cluster (DNS)*
3. *Distance of node from centriod of cluster (DNC)*

The residual energy (RE) is the most important variable which can affect the network lifetime. If a node with low RE decides to become a CH, it would be soon dead. For higher RE node, priority to become CH is more. The distance between a node and the sink (DNS) determines the energy consumption of the node. The distance between node and the centroid of cluster (DNC) is also important, because the shorter the distance from the centroid of cluster, the smaller the summation of intra-cluster distances. These input variables are considered to avoid selecting low energy nodes (RE) to minimize the total energy consumption of nodes (DNS and DNC). A typical Sugeno fuzzy rule with three inputs *x, y* and *z*, (RE, DNS, DNC) and one output *w* can be shown as

$$IF = p \times x + q \times y + r \times z$$

Where p, q, r, are weight age of three variables, RE, DNS, DNC. We considered there values as 0.5, 0.3, 0.2 in the order of priorities.

Normalization function used to normalize input variable with in required range is given below.

$$Normalized\ x_i = \frac{x_i - \min(x)}{\max(x) - \min(x)}$$

3.1 Algorithm Steps

A step by step algorithm for the proposed work is given as:

STEP1. Initialize the agent population random positions and other constants.

STEP2. Apply K-means clustering technique to make clusters of nodes and their centroids.

STEP3. Create an objective function which can calculate RE, DNS. DNC and also choose CH on the basis of RE and calculates mean RE of clusters and total node population.

STEP4. Create a Fuzzy Inference System FIS using Sugeno function for three inputs RE,DNS,DNC and make their membership function and rule set to decide output.

STEP5. Initialize random positions and directions of agents in GSA

STEP6. Consider the searching space dimension as number of membership function values to be tuned which is 15 in our case.

STEP7. For each agents' position, calculate the fitness function value.

STEP8. Now select the minimum fitness value amongst previous and current value. Calculate the mass of agent which will be used to update the position of agents. The mass can be calculated as

$$m_i(t) = \frac{fit(t) - worst(t)}{best(t) - worst(t)}$$

$$M_i(t) = \frac{m_i(t)}{\sum_{j=1}^{N} m_j(t)}$$

STEP9. using this mass value for each agent, calculate the force by using below formula

$$F_{ij}^d(t) = G(t).\left(M_{pi}(t) \times \frac{M_{ai}(t)}{R_{ij}(t)} + \varepsilon\right).(x_j^d(t) - x_i^d(t))$$

STEP10. This force is used to calculate the acceleration of agent which will be used to update the agents position as

$$a_i^d(t) = F_i^d(t)/M_{ii}(t)$$

$$v_i^d(t+1) = rand_i x v_i^d(t) + a_i^d(t)$$

$$x_i^d(t+1) = v_i^d(t+1) + x_i^d(t)$$

STEP11. Result will be positions of agents with minimum fitness function output. These positions are membership function's tuned variables for fuzzy logic controller.

4. Result

In our work we have proposed a technique for increasing the lifetime of a wireless sensor network (WSN) using fuzzy logic controller and GSA search algorithm. In our work we have proposed a technique for increasing the lifetime of a wireless sensor network (WSN) using fuzzy logic controller and GSA search algorithm.The proposed work is implemented in MATLAB R 2016a. A lot of inbuilt functions in MATLAB makes the use easier and saves our time to build our code from scratch, so we can use that time in problem solution of research. The basic description of MATLAB is given in appendix. We have developed our code in modules and are named as per their functions. These designed functions are called in main script, and user doesn't need to use them or call them separately.

We have divided our work in fivesub cases which are

1. Create X no of nodes in wireless sensor network to make WSN environment. Divide in 3 clusters using Kmeans clustering technique.
2. Create Fuzzy inference system (FIS) file using three inputs and three membership functions of each inputs with a set of 27 rules to choose output.
3. Apply GSA algorithm to tune input parameters of FIS.
4. Apply ABC algorithm to tune input parameters of FIS.
5. Comparison of results of both GSA and ABC.

Case-1 When Geographical area is 100mx100m

When geographical area is 100 m^2 then we calculated and observed imapct of GSA and ABC algorithm on increasing the lifetime of WSN. Here are results of this case:

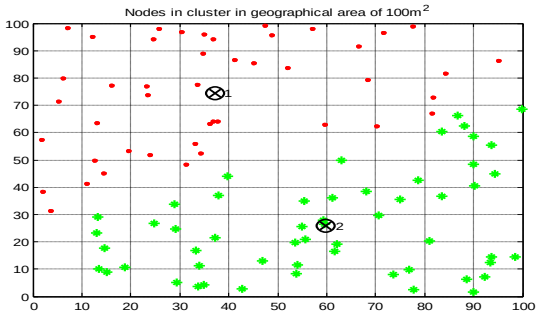

Figure 2: Nodes in cluster in geographical area of 100 m^2

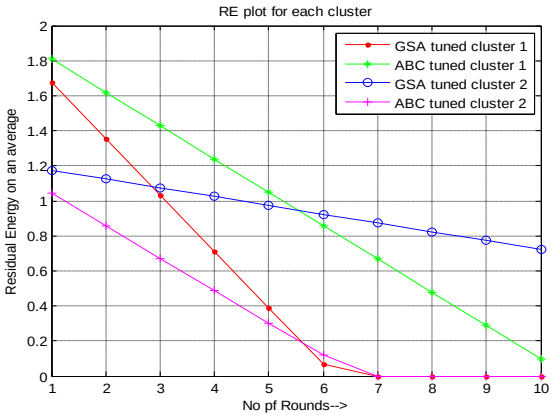

Figure 3: RE plot of GSA and ABC

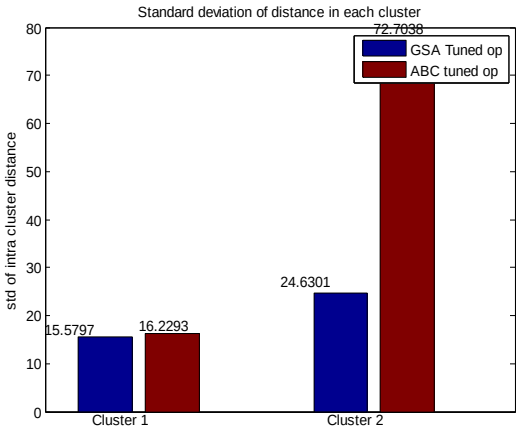

Figure 4: Standard deviation of cluster distance

Table 1: Cluster-wise comparsion for GSA and ABC for case-1

Case-3 100m^2	**Cluster 1**	**Cluster 2**
GSA	15.5797	24.6301
ABC	16.2293	72.7038

5. Conclusion

Our thesis work includes the study of clustering. Cluster head (CH) selection and other energy efficient communication protocols such as ABC and GSA optimization algorithms for WSN, since it was proposed earlier that clustering improves the network lifetime. We used Fuzzy logic controller based approach for cluster head choosing and compared performance of GSA and ABC for cluster head selection and improvement of network lifetime. It was also found that the GSA tuned Fuzzy controller gives better results than ABC tuned parameters. For clustering, a WSN environment with different geographical area size is considered which is clustered by K-Means technique. We used ABC as a reference to compare the performance of each of the clustering methods. It is concluded that for three different geographical sizes GSA tuned fuzzy logic controller gives improved result in respect of network lifetime in comparison to ABC algorithm. As geographical size increases impact of GSA becomes comparable to that of ABC but for smaller areas GSA should be preferred over ABC for longer network lifetime.

References

1. Q. Yu, Z. Luo and P. Min, "Intrusion detection in wireless sensor networks for destructive intruders," *2015 Asia-Pacific Signal and Information Processing Association Annual Summit and Conference (APSIPA)*, Hong Kong, 2015, pp. 68-75.
2. P. R. Vamsi and K. Kant, "Secure data aggregation and intrusion detection in wireless sensor networks," *2015 International Conference on Signal Processing and Communication (ICSC)*, Noida, 2015, pp. 127-131.
3. Ajith Abraham, Crina Grosan and Carlos Martin-Vide, "Evolutionary Design of Intrusion Detection Programs," International Journal of Network Security, Vol.4, No.3, PP.328–339, Mar. 2007.
4. Ioannis Krontiris, Zinaida Benenson, Thanassis Giannetsos, Felix C. Freiling and Tassos Dimitriou, "Cooperative Intrusion Detection in Wireless Sensor Networks.
5. Djallel Eddine Boubiche and Azeddine Bilami, "CROSS LAYER INTRUSION DETECTION SYSTEM FOR WIRELESS SENSOR NETWORK," International Journal of Network Security & Its Applications (IJNSA), Vol.4, No.2, March 2012.
6. Shio Kumar Singh, M P Singh and D K Singh, "Intrusion Detection Based Security Solution for Cluster-Based Wireless Sensor Networks," International Journal of Advanced Science and Technology, Vol.30, May,2011.

7. A. Anbumozhi, K.Muneeswaran, Sivakasi, “Detection of Intruders in Wireless Sensor Networks Using Anomaly,” International Journal of Innovative Research in Science, Engineering and Technology, Volume 3, Special Issue 3, March 2014.
8. Joseph Rish Simenthy CEng , AMIE, K. Vijayan, “Advanced Intrusion Detection System for Wireless,” International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, an ISO 3297: 2007 Certified Organization Vol. 3, Special Issue 3, April 2014.
9. M. Riecker, A. Barroso, M. Hollick and S. Biedermann, "On Data-Centric Intrusion Detection in Wireless Sensor Networks," *2012 IEEE International Conference on Green Computing and Communications*, Besancon, 2012, pp. 325-334.
10. F. Bao, I. R. Chen, M. Chang and J. H. Cho, "Trust-Based Intrusion Detection in Wireless Sensor Networks," *2011 IEEE International Conference on Communications (ICC)*, Kyoto, 2011, pp. 1-6.
11. G. S. Brar, S. Rani, V. Chopra, R. Malhotra, H. Song and S. H. Ahmed, "Energy Efficient Direction-Based PDORP Routing Protocol for WSN," in *IEEE Access*, vol. 4, no. , pp. 3182-3194, 2016.
12. L. Coppolino, S. DAntonio, A. Garofalo and L. Romano, "Applying Data Mining Techniques to Intrusion Detection in Wireless Sensor Networks," *2013 Eighth International Conference on P2P, Parallel, Grid, Cloud and Internet Computing*, Compiegne, 2013, pp. 247-254.
13. R. Bhargavi, V. Vaidehi, P. T. V. Bhuvaneswari, P. Balamuralidhar and M. G. Chandra, "Complex Event Processing for object tracking and intrusion detection in Wireless Sensor Networks," *2010 11th International Conference on Control Automation Robotics & Vision*, Singapore, 2010, pp. 848-853.
14. Harmandeep Kaur, “A Novel Approach To Prevent Black Hole Attack In Wireless Sensor Network”International Journal For Advance Research In Engineering And Technology, Vol. 2, Issue VI, June 2014.
15. Anurag Singh Tomar, “Optimized Positioning Of Multiple Base Station for Black Hole Attack” International Journal of Advanced Research in Computer Engineering & Technology Volume 3 Issue 8, August 2014.
16. Sowmya K.S, “Detection and Prevention of Blackhole Attack in MANET Using ACO” International Journal of Computer Science and Network Security, VOL.12 No.5, May 2012.
17. Manvi Arya, “BFO Based Optimized Positioning For Black Hole Attack Mitigation in WSN” International Journal of Engineering Trends and Technology (IJETT) – Volume 14 Number 1 – Aug 2014.
18. Yash Pal Singh, “A Survey on Detection and Prevention of Black Hole Attack in AODV-based MANETs” journal of information, knowledge and research in computer engineering, nov12 to oct13 ,volume – 02, issue – 02.
19. Kiran Narang, “Black Hole Attack Detection using Fuzzy Logic” International Journal of Science and Research, Volume 2 Issue 8, August 2013.
20. Rajani Narayan, “Self-optimization and Self-Protection in AODV Based Wireless Sensor Network” International Journal of Computer Science and Mobile Computing, Vol.3 Issue.1, January- 2014, pg. 244-254.