ENERGY EFFICIENT NODE DEPLOYMENT IN WSN

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ABSTRACT

A wireless sensors network comprises of randomly deployed small devices which provides reliable and effective communication over wireless network. They have the tendency to detect physical conditions environmental changes, in real time, such as pressure, light, temperature and humidity etc. The main areas of issues in WSN are power conservation, routing, data rates, memory etc. Enormous research has been done in WSN till date and it has huge potential to revolutionize human computer interaction in the coming future. Multiple solutions have been provided to combat various challenges based on the type of services required. This dissertation focuses on the power issues in WSN and efforts have been made to provide optimal power solution for node deployment using cluster-based algorithm. The clustering approach has been combined with the existing Fuzzy Self-Healing Algorithm. The simulations are done using NS-2.35 and results have been analyzed. It achieved greater power optimization and reduced time, hence enhancing the overall network lifetime. Hence, providing better performance in terms of power consumption and efficient communication

1. INTRODUCTION

The increasing number of smart application based on energy management and inexpensive and standard MCUs are creating demand for actuators/sensor networks in the market which also including building automation, telemedicine, home and lighting. Wireless sensors network is a simple and economic step towards the deployment of control devices and distributed monitors. They avoid expensive retro fits required in wired systems. But there are some challenges and limitations associated with the wireless protocols faced by the application developers that continue to persist such as limited bandwidth, in experience with RF design and confusing profusion of protocols [1]. A wireless sensors network (Figure 1) is a comprises of randomly deployed small devices which provide various features such as; the tendency to detect physical conditions environmental changes, in real time, such as pressure, light, temperature and humidity etc. WSN have the ability to operate these types of devices as switches, actuators or motors that are used to control those conditions and also provide a reliable and effective communication over wireless network [2]. Davood Izadi et al (2015) proposed the algorithms determining the uncovered sensing areas and moving best suitable mobile node to minimize coverage hole. Yunzhou ZHANG et al (2009) [3] proposed new methods to minimize the number of nodes and maximize detection probability. This paper has adapted Delaunay Triangulation method (no point P must lay inside the circum-circle of any triangle, for a set of P of points in a plane in a triangulation) for the deployment of new nodes. Edwin Prem Kumar Gilbert et al (2012) proposed various issues in application of Wireless Sensor Networks.[4]

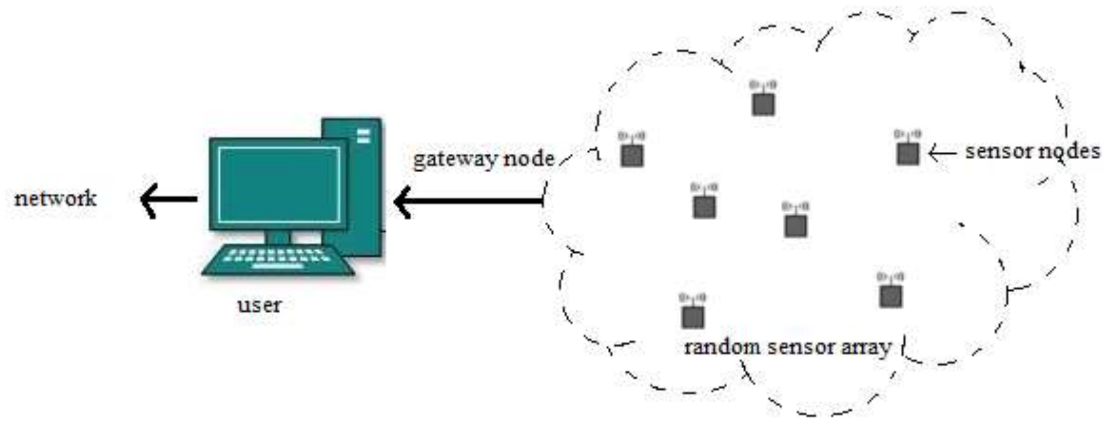

Figure 1: Wireless Sensor/Actuator Network.

Zhao Han et al (2014) proposed GSTEB protocol i.e. General Self-Organized Tree-Based Energy-Balance routing protocol. In this a routing tree is formed. For each round the based station selects a root node and this information is broadcasted to the entire network. Each node in the network subsequently selects its parent node using only its own and neighbor's information which results in a dynamic protocol. Its performance is better as compared to other balance energy consumption protocol thus the network lifetime is extended [3].

Deze Zeng et al (2015)[6] proposed his work on Software-defined Sensor Network (SDSN), mainly focused on sensor activation, task mapping, sensing rate scheduling, and energy efficiency. Moumita Samanta and Indrajit Banerjee (2014)[7] proposed a method of distribution of load of the cluster head that would be beneficial in supporting fault tolerance. In this paper static nodes are deployed both uniformly and non-uniformly. Prasenjit Chanak and Indrajit Banerjee (2014) [8] proposed a scheme for movement of mobile sinks. The main aim of the paper is to construct a strategy to achieve the most optimal path for the movement of mobile sinks. Various sub regions are created in the network topology that, are coupled with a quad tree.

Fatme El-Moukaddem et al [9] (2014) proposed an algorithm to extend the networks life time by rotation of the nodes in a sensors network. The proposed method addresses the differential consumption of power and increasing the lifetime of a wireless sensor network. They proposed algorithm for both single round as well as multiple round rotation network life time. The experimental results show that with the nodes rotation the lifetime of wireless sensor network topology increases up to eight times. [10] Tripti Sharma et al (2014) proposed an algorithm based on ACO and have applied Low Energy Adaptive Clustering Hierarchy (LEACH) protocol on it. The ACO (Ant Colony Optimization) is a swarm optimization based techniques used for network routing. Deepali and Padmavati (2014) proposed a routing protocol for sink mobility. Improvements in the existing EESSC protocols are made. The EESSC protocol i.e. Energy efficiency semi- static clustering is based on energy awareness. It's a semi static clustering protocol that involves formation of clusters based on remaining energy.

2. PROBLEM FORMULATION

The random node deployment by Davood Izadi et al (2015) [1] employee fuzzy based self- healing coverage algorithm that is used to determine the uncovered areas and then the best mobile node is selected, which moves to cover the coverage hole. This coverage hole can be due to failure of node due to any physical damage or battery drainage, or the inability of the mobile node to communicate. This can happen due do environmental interferences. Since the distance of the nodes are not uniform due to random topology of mobile nodes. The node selection is considers the Euclidean distance and coverage redundancy. The mobile nodes do not have the knowledge of the entire network topology rather they have the knowledge about their neighboring nodes only. The objective of the proposed work was to maximize coverage, to make sure that the mobile nodes are located at equal Euclidian distance to each other, to reduce redundancy of data and finally to minimize the power consumption.

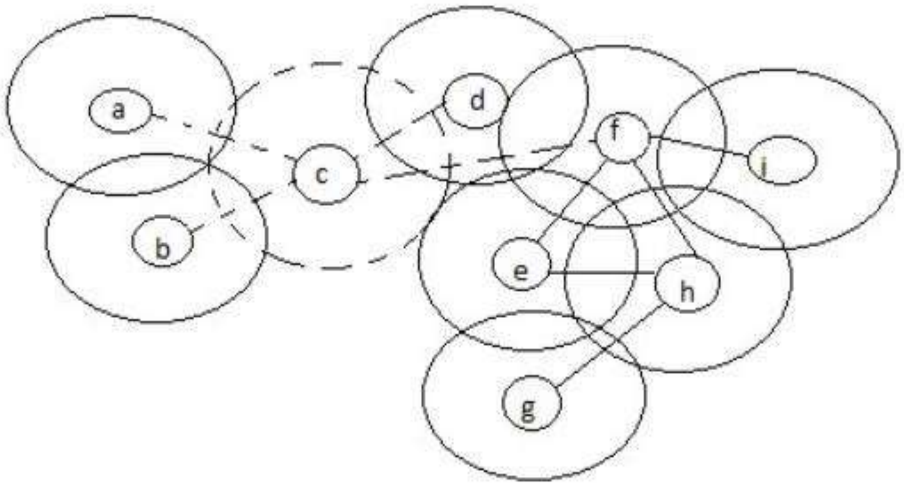

Figure 2: A Failed Node in WSN.

This signal is used by the neighbour mobile nodes to calculate the Euclidian distance between them. It also detects whether the node is noisy or not. In case the node is noisy it is considered as node failure and the nodes move to minimize the coverage hole. The data redundancy is checked by comparing the energies of the received signal.

3. PROPOSED SCHEME

In this dissertation the aim to minimize the power consumption by forming cluster heads. This dissertation proposed a clustered fuzzy self-healing algorithm (CFSHC) which enhances the efficiency of FSHC. It would reduce the power consumed to regularly send pulse messages to various neighboring nodes. Since the nodes can only send one pulse message to the selected cluster head, thus indicating about its existence and its functionalities. In addition to this node need not to continuously calculate their Euclidian distance for every neighbour as cluster head will be responsible for formation of the topology and calculation. This would further reduce the power consumption. The selection of the cluster head will be based upon the power availability of the mobile nodes.

The cluster head will change at regular intervals so that node does not experience complete power drain. As more energy is consumed by the cluster head as compared to the cluster member nodes. Also, during clustering will reduce the redundancy as all the member nodes will communicate with their respective head. Hence redundancy can be removed at once. This will further reduce the power consumption as each nod does not need to check for redundant data received by receiver. And at last it will also eliminate the need of "Self-relocation ON/OFF" messages send by mobile nodes to their neighbors while relocating as cluster head will have the knowledge about the movement of the member nodes, thus reducing control heads messages and hence energy consumption.

Parameters and Formulas

- Number of nodes- 80
- Routing protocol- DSR

- Sensing Field- 450m X 400m
- Communication Range up to- 44m
- Sensing Range- 25m
- Initial Energy- 10 J
- Noise Factor (Nth)- 0.0001
- Sleep Power-0.00005
- Transmission Time- 0.005
- Transmission Power- 0.002
- Ideal Power- 1.0

The channel is wireless, and two-ray propagation is the radio propagation model. Interface taken is wireless and the MAC type is MAC/802_11. CMU primary queue is the interface queue type and the maximum number of packet in the interface queue can be taken as 500. A UDP agent and nodes are attached. The null agent is connected to a UDP agent. This null agent releases the received packets. Also CBR and FTP (traffic generator) are connected to UDP and TCP respectively.

The nodes are randomly deployed, and the link is created between the nodes if the distance between them is less than 25, i.e. the sensing range. Since they are not uniformly deployed thus few areas remain uncovered and some nodes cannot create a link hence communication is not possible therefore the aim is to relocate them to the desired area. In this network the mobile nodes are communicating with the neighboring nodes. They need to continuously send pulse messages to the neighbors to ensure their functionality. Also the nodes are continuously calculating the Euclidian distance between them and their neighboring nodes since the topology keeps on changing. And while relocating the "Self-relocation ON/OFF" messages are being transmitted to neighbor nodes which are further being transmitted by them. In this case power consumption is continuously used to send information signal to the neighbor continuously at fixed intervals.

4. RESULTS AND DISCUSSIONS

Results obtained shows that the network life time is increased significantly. Also the consumed energy is greatly reduced. We have considered the network lifetime till the last node dies, hence as the energy consumed is less therefore the network life time is greatly enhanced. The coverage results shows 99% coverage which were around 90-95% in case of FSHC. Figure shows that the remaining energy of the proposed work is more as compared to the energy in case of FSHC for 80 nodes. It also the iteration time is less as compared to FSHC. Figure 3 shows the energy of the proposed work and energy in case of FSHC for 60 nodes. Figure 4 also shows the same graph for 40 nodes.

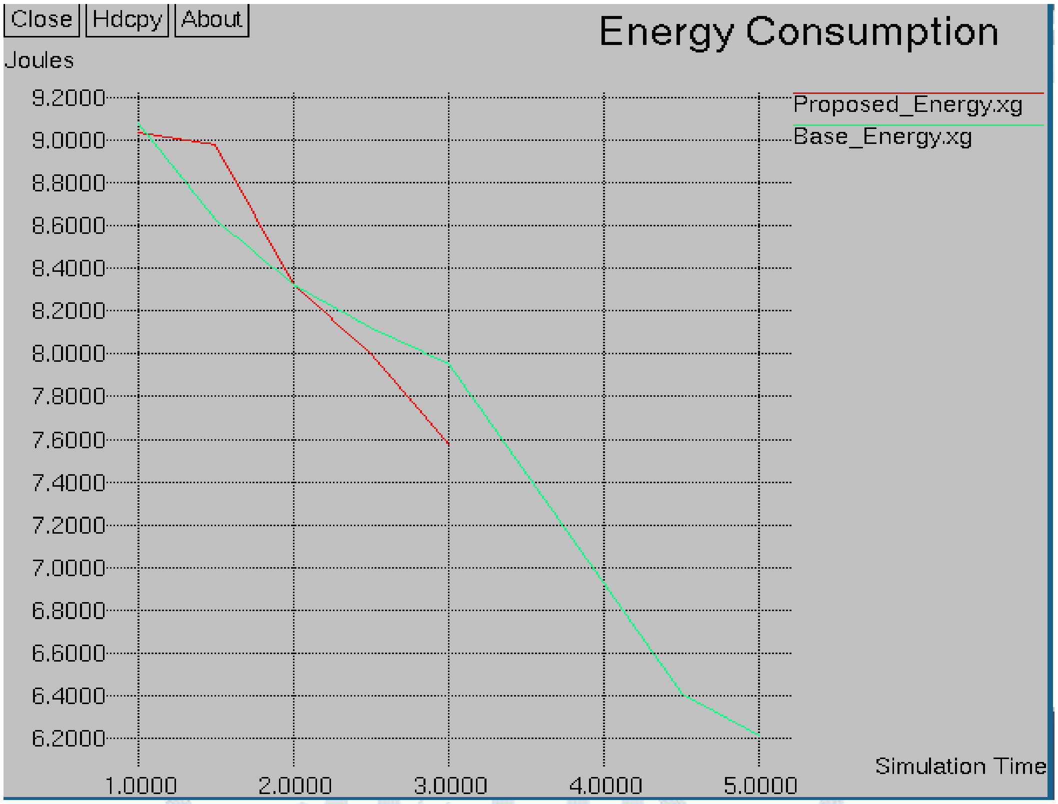

Fig 3:- Remaining Energy for 80 nodes in Base Problem and Proposed Work.

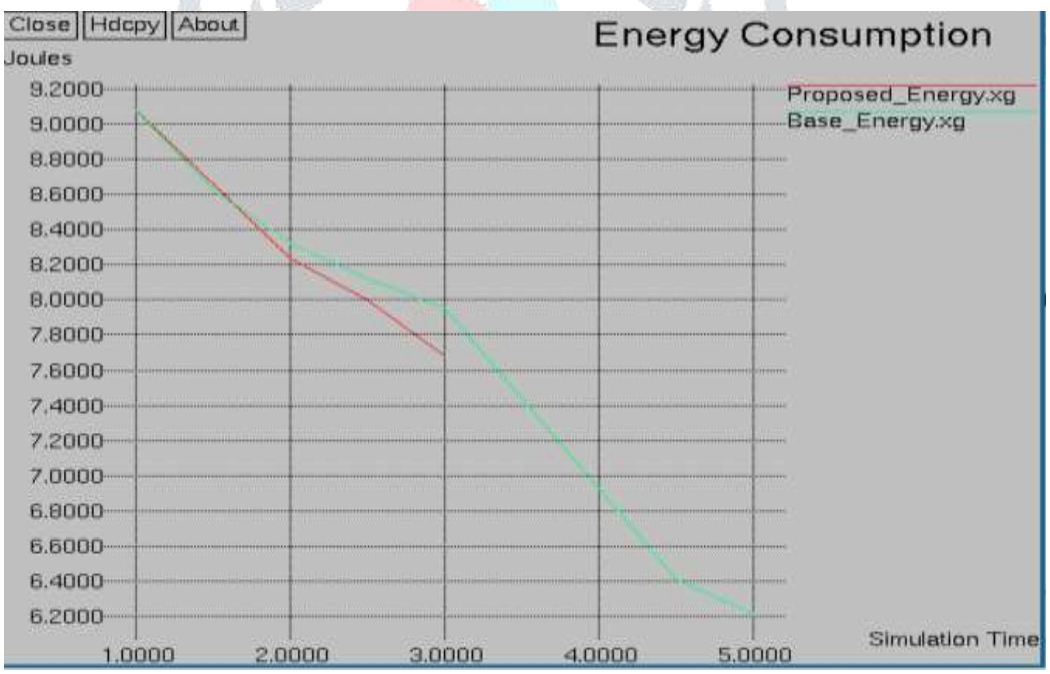

Figure 4: Remaining Energy for 60 nodes in Base Problem and Proposed Work.

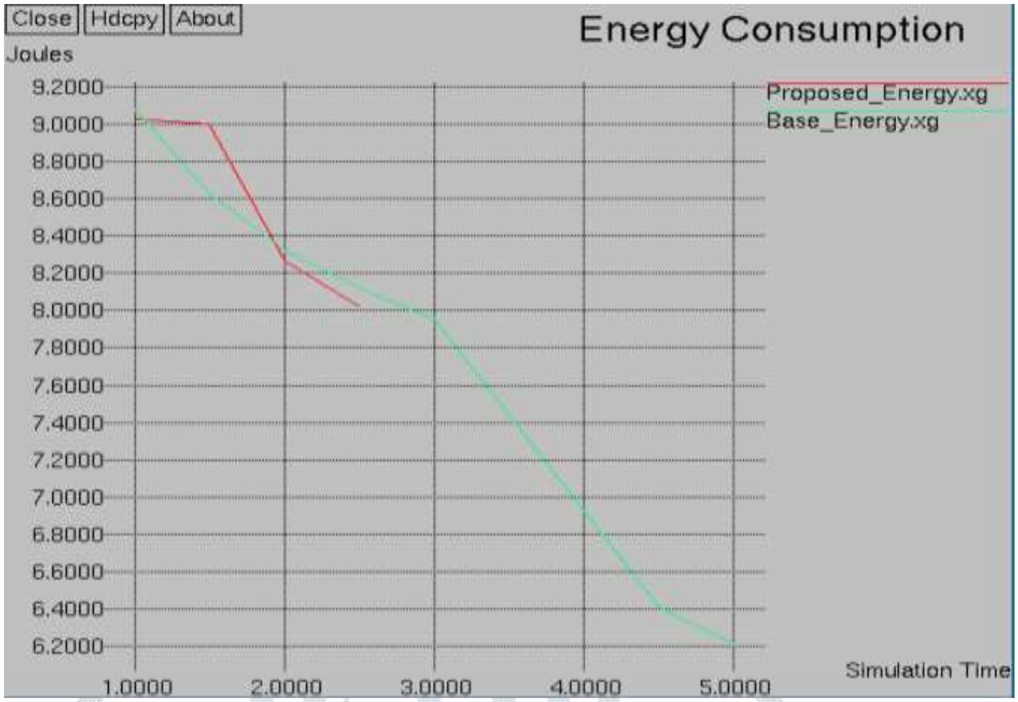

Figure 5: Remaining Energy for 60 nodes in Base Problem and Proposed Work.

5. CONCLUSION AND FUTURE SCOPE

This paper gives idea about various kind of research work that has already been done in this field. Work already been done in WSN, limitations and challenges faced in this field. It helped in gaining familiarity with latest areas of research, different models and algorithm proposed, different approaches to improve the working/efficiency/performance of WSN. Problem has been formulated in this dissertation and efforts have been made to provide the solution if the same. With the proposed algorithm energy consumption reduced, which in turn will enhance the network life time. The proposed model CFSHC is the enhanced version of FSHC. That randomly deploys nodes to maximize the coverage ratio. The coverage ratio is 99.9% and the energy consumed is reduced. The simulation results uphold the efficiency and effectiveness of the proposed work. The results are compared with FSHC and provided better results.

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