International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-6, Issue-2, October 2016

An Effective Protected Multilayered Energy Harvesting and Aggregation of Underwater Networks for Enhancing Performance

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***Abstract*— Wireless Acoustic Networks and related energy based lifetime enhancement is one of the key domain of research in marine based engineering. Underwater acoustic sensor networks enable a broad range of applications, including Ocean Sampling Network, Undersea Exploration, Environmental Monitoring, Disaster Prevention, Equipment Monitoring, Assisted Navigation, Seismic Monitoring, Distributed Tactical Surveillance, Mine Reconnaissance and many others. Design and Challenges with the underwater and related sensor technologies include Node Deployment, Limited Energy, Computational Capacities and Memory, Network Dynamics, Energy Efficiency, Data Aggregation, Node/Link Heterogeneity, Fault tolerance and reliability. A number of algorithms, protocols and approaches are developed so far for effective optimization of acoustic resources still a huge scope of research is there. In this research work, an effective and novel algorithm for energy harvesting is proposed using which the effective lifetime of the network can be enhanced. Using this approach, the solar based energy harvesting and optimization can be done with overall cost reduction. This will facilitate the research efforts in combining the existing solutions to offer a more energy efficient routing mechanism using the specialized technique of making use of the minimum distance vector from the base station of every node. For this the integration of fuzzy based mathematical formulation is done.**

***Index Terms*— UWSN, Underwater Sensor Networks, Energy Harvesting.**

I. INTRODUCTION

As we wholly classifies that computer science had magnificently positioned the sensor network on earth, even then underwater is unscathed area and our 2/3rd portion of globe is seawater. Underwater sensor networks (UWSN) are the emergent and auspicious announcement framework which strengthens a wide range of applications. The characteristics of partial existing bandwidth, huge propagation delay and high bit fault rate (BFR) have many essential challenges.

Underwater acoustic sensor networks enable a broad range of applications, including Ocean Sampling Network, Undersea Exploration, Environmental Monitoring, Disaster Prevention, Equipment Monitoring, Assisted Navigation, Seismic Monitoring, Distributed Tactical Surveillance, Mine Reconnaissance and many others.

Design and Challenges with the underwater and related sensor technologies include Node Deployment, Limited Energy, Computational Capacities and Memory, Network Dynamics, Energy Efficiency, Data Aggregation, Node/Link Heterogeneity, Fault tolerance and reliability.

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II. LITERATURE SURVEY

Author [Reference]	**Work Done**
Raymond Mulligan et.al [1]	"The key work done in this paper is on energy optimization and overall lifetime enhancement. The authors develop and simulate a novel approach or energy optimization in this work."
Chetan Chugh et.al [2]	"The work is having focus on the security and integrity which is directly related to the overall lifetime of the network. The paper works on dynamic and public key cryptography for higher efficiency."
Wendi B.Heinzelman et.al [3]	"The paper is working on the development of low-energy adaptive clustering hierarchy or simply LEACH protocol that is associated with the underwater sensor networks."
Wendi Rabiner Heinzelman et.al [4]	"Work done on communication protocols, for multihop routing, transmission-energy and clustering"
M. J. Handy et.al [5]	"Focus on the reduction of power consumption of wireless microsensor networks."
Saha Misra et.al [6]	"Development of a novel approach enhanced energy efficient adaptive clustering (EEEAC) protocol based on the residual energy of each node within the network."
V.Loscri et.al [7]	"The authors propose and implement the improved Low Energy Adaptive Clustering Hierarchy (LEACH)"
Yongcai Wang et.al [8]	"Development of a novel and effective EDAC (Energy-Driven Adaptive Clustering) protocol"
Weilian Su et.al [9]	"This work points out the open research issues and intends to spark the new paradigms, interests and developments in the domain of wireless technology."
Paolo Baronti et.al [10]	"The focus in this paper is to energy optimize and enhancement of overall lifetime related to underwater sensor networks. The authors develop and simulate a novel approach or energy optimization in this work."

III. PROBLEM FORMULATION AND HYPOTHESIS

The existing approaches make use of static and prior knowledge based cluster head formation. There is the need to integrate fuzzy mathematical modeling so that the cluster head selected is dynamic and entire network can be fault tolerant.

IV. PROPOSED WORK AND ALGORITHM

Proposed work is performed in MATLAB. In order to maximize the lifetime of the network, we introduce IFBA (Improved Fuzzy Based Approach). The objectives of the proposed research work are discussed as follows:

1. To develop an efficient algorithmic approach for cluster head selection in the wireless sensor networks.
2. To develop the module for integration with the algorithm for simulation of the energy optimization based on the fuzzy logic.
3. Removal of Redundant Links to improve the lifetime of the dynamic cluster head.
4. To perform clustering/aggregation of sensor motes and dynamic selection of the cluster head.
5. To optimize the energy level of the wireless sensor nodes in the region under simulation.
6. To improve the efficiency and performance of the sensor nodes in terms of lifetime.

The proposed algorithm is known as Fuzzy Integrated Density and Energy Optimization

Algorithm (IFBA). Steps are as follows:

1. *Read WSN Nodes {WSN[i]; i<=n}.*

2. *Generate Dynamic Graph of the Nodes.*

3. *Measure the Density of each node based on the ratio of the number of links between and to neighbors of u over the degree of u: $\rho(u) = (V, w) \in E' \mid V \in \{u, N(u)\}, w \in N(u) / \delta(u)$.*

4. *Add Random Number to the measured density of each node to avoid any biasing.*

5. *Allocation of the Cluster Head shall be based on the Threshold Value.*

6. *The Threshold Value shall be compared with all nearby densities and minimum difference in the densities shall be the factor.*

7. *Suppose the densities are -> 1.2, 3.2, 3.0, 4.9, 2.5. Now, a dynamic threshold based the average of all these will be taken.*

8. *Then, the most near value to the threshold shall be considered as Cluster Head.*

9. *The comparison parameters / graphs shall be:*

- *Energy Optimization / Conservation between Existing (BLAC) and IFBA Approach.*
- *Cost Factor between Existing and IFBA Approach.*

V. RESULTS AND DISCUSSION

The purpose of this research work is to facilitate the research efforts in combining the existing solutions to offer a more energy efficient routing mechanism using the specialized technique of making use of the minimum distance vector from the base station of every node. In the proposed approach, the integration of fuzzy based mathematical formulation is done. The proposed IFBA (Improved Fuzzy Based Approach) starts with reading the wireless sensor nodes. After this step, the generation and activation of the dynamic graphs of nodes is implemented. Measurement of the Density of each node based on the ratio of the number of links between and to neighbors is implemented with the addition of random number to the measured density of each node to avoid any biasing. This process is followed by the allocation of the Cluster Head shall be based on the Threshold Value. The Threshold Value shall be compared with all nearby densities and minimum difference in the densities shall be the factor. Then, the most near value to the threshold shall be considered as Cluster-Head. Figure 1 shows all these steps in a flow diagram.

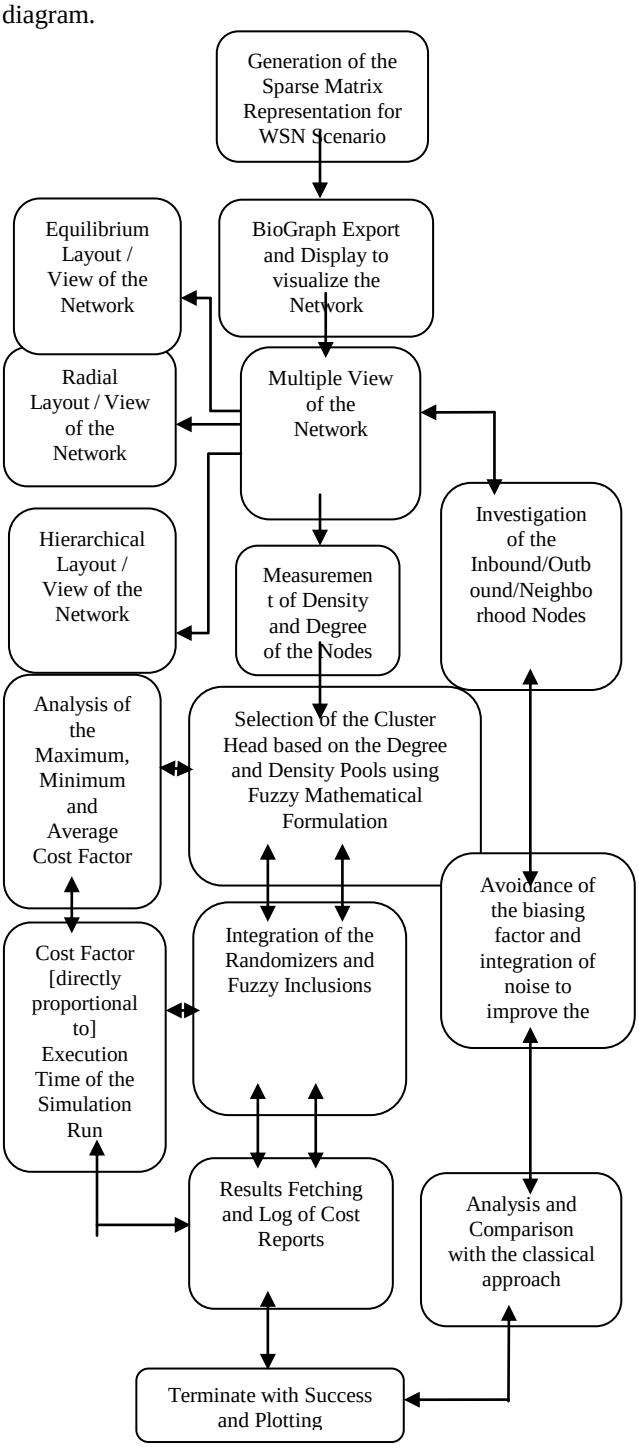

Figure 1 Flow Diagram

Figure 1 shows view of the wireless links after the implementation of Improved Fuzzy Based Approach. In the proposed approach, the use of fuzzy implementation empowers the network with multiple cluster heads. Using this technique, the same value nodes will be equally assigned the role of cluster head (CH). It is very useful in case of the

development of fault tolerant model. The proposed work is based on disaster recovery/fault tolerant architecture by which the alternate nodes can take over the charge / role of CH.

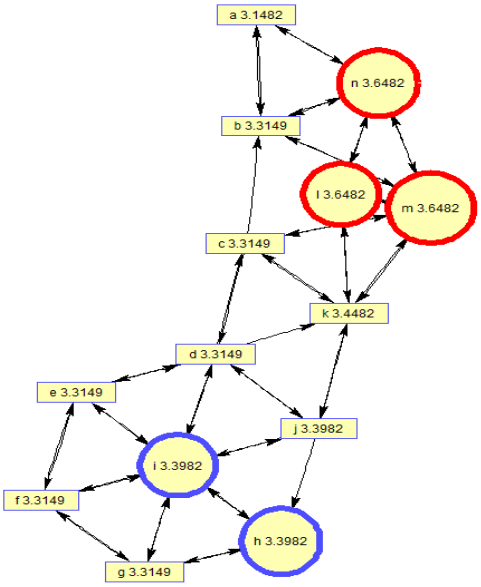

Figure 2 - View of the Wireless links

Figure shows point and stem view of the cost factor in proposed approach i.e. IFBA approach. Here, on x-axis minimum cost is 1, average cost is 2 and a maximum cost is 3.

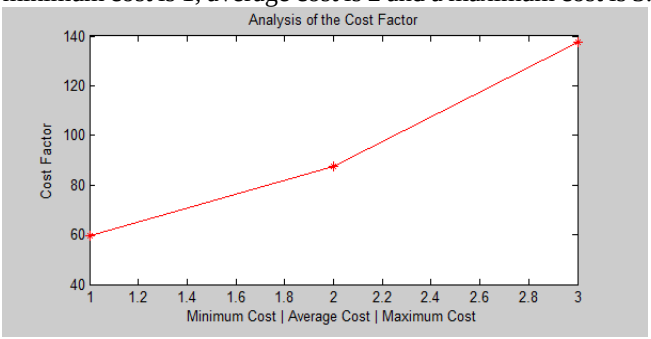

Figure 3 Point and Stem View of the Cost Factor in Proposed Approach

Figure shows simulation attempts on x-axis and cost factor on y-axis to analysis and to cumulative graph of existing and proposed approach.

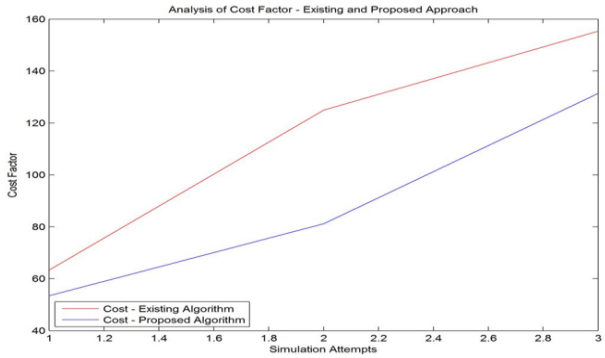

Figure 4 - Cumulative Graph of Existing and Proposed Approach

VI. CONCLUSION AND SCOPE OF FUTURE WORK

Energy optimization is one of the most touched areas in the domain of wireless sensor networks can effectively act in multiple applications. Cross-layer is becoming an important studying area for wireless communications. So we can use cross-layer to make the optimal modulation to improve the transmission performance, such as data rate, energy efficiency, QoS (Quality of Service), etc. Sensor nodes can be imagined as small computers, extremely basic in terms of their interfaces and their components. For future scope of the work, the techniques including Artificial Neural Networks, Genetic Algorithmic Approaches, WCA (weighted clustering algorithm).can be used in hybrid approach to better and efficient results

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