ISSN (Online) : 2348 - 2001

International Refereed Journal of Reviews and Research
Volume 2 Issue 6 November 2014
International Manuscript ID : 23482001V2I6112014-71
(Approved and Registered with Govt. of India)

EFFECTIVE MULTILAYERED ENERGY HARVESTING AND AGGREGATION IN ASSORTED NETWORKS

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Abstract. Underwater Acoustic Networks and related energy based lifetime enhancement is one of the key domain of research in marine based engineering. 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.

Keywords: UWSN, Underwater Sensor Networks, Energy Harvesting

Introduction

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

Underwater acoustic sensor networks enable a broad range of applications, including:

- Ocean Sampling Network
- Environmental Monitoring
- Undersea Exploration
- Disaster Prevention

- Seismic Monitoring
- Equipment Monitoring
- Assisted Navigation
- Distributed Tactical Surveillance
- Mine Reconnaissance

Design and Challenges

- Node Deployment
- Limited Energy, Computational Capacities and Memory
- Network Dynamics
- Energy Efficiency
- Data Aggregation
- Node/Link Heterogeneity
- Fault tolerance and reliability

PROPOSED ALGORITHMIC APPROACH

WORK CARRIED OUT

In this research work, a novel approach using Multi Hop or Multilayered Energy Efficient & Reliable Scheme for Underwater Wireless Sensor Networks is proposed and implemented which is energy efficient and at the same time, it provides scalability as well. To reduce energy, the author uses the concept of data aggregator which acts as super node which collects the data from normal sensor nodes and forwards to floating sink thus saves energy and floating sink further aggregates the data from aggregator and forwards to the satellite then satellite send the data to the base station thus further reduction in energy, in the case if data aggregator fails then any heterogeneous node in the network takes control over that because all the nodes are connected with AUV so there is the depth adjustment mechanism is there for transfer the data from one level to another level. As we are improving the data transmission rate by using the acoustic signals. Second thing to resolve the problem of reliable power source we are introducing the concept of energy harvesting from tidal energy to electrical energy, due to this our sensor batteries always remains fully charged.

1. Initialize WSN[n] => Array of Sensor Nodes {n<reqdNodesRandom}
2. Initialize L[m] => Array of Layers {m<=3)
3. Deploy nodes with Random Positions {PS[j] =>WSN[n]}=>L[m]
4. Energy Vector[k] Initialization and Activation
5. Activate Energy Vector[k], L[m] and WSN[n] for recursive operations and measurements.

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6. Initialize l=random rounds () [Random Rounds Activated]
7. for (v=0;v<=l;v++)
Calculate MV[WSN[i][j]) Movement and Energy Vector
End
8. Measure Energy Vector of Each Node
9. Update EV [Energy Vector]
10. If EV<=Th (Threshold)
Activate BS[i] => Base Stations
Communication Vector (CV) =>STl[i] => Satellite
Recharing Charging[i]=>TidalWaves[Vector]
11. If EV <Reqd Vector Then go to step7 in Recursive manner
12. Generate Vectors of Energy Consumed, Energy Throughput and related parameters

ENERGY RE-GAIN IN UWSN

In this chapter the author will discuss the new model to conserve the energy between the sensor nodes to get the reliability of our network. As we are implanting the Aquanodes (sensors) in the random manner at three levels in the ocean, Top level, Middle level and Bottom level. The Aquanodes which we deploy at the top level and bottom level they are static but the Aquanodes which are in the middle level they are attached with AUV'S, we are using these AUV'S just because to overcome any exception like if any node will destroy from any animal or from any disaster like earthquake comes under the oceans. Secondly we are introducing the concept of Energy-Harvesting at multi-level from the Tidal Energy to recharge the sensor batteries.

PROPOSED DEPLOYMENT APPROACH

Network is positioned with an assumption of heterogeneous deployment of nodes in terms of energy and bandwidth. For energy efficiency we use data aggregator, which is use as the gateway. So it is evident that we have used a hierarchical arrangement in our network. The benefit of a hierarchical system over a flat system is that it is more energy efficient and easy to collect data. We are deploying the sensors at three levels, which are mentioned below:-

- Bottom Level of Ocean
- Middle Level of Ocean
- Top Level of Ocean

As to deploy any network some hardware things is required and in consider of deployment in underwater we are using the following hardware to design our network:-

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- Aquanodes
- Data Aggregator
- AUV’s
- Surface Sink
- Satellite

BOTTOM LEVEL OF OCEAN (SEA LEVEL)

First we specify the area in which we have to deploy the sensor network. At the bottom level we are using Aquanodes which are also called sensor nodes and data aggregator to transfer the collected data to the surface sink. Then we will deploy the sensor randomly on the bottom of the ocean, these all sensors are communicate with each other with the hop to hop communication technique, we can also call it Cooperative Diversity.

The Cooperative Diversity consists of a source node, a partner node and a destination node. We assume that the cooperative diversity operates under the selection, decode and forward cooperative scheme. Which has two phases, in first phase a node decode and forward, the partner node receive then it will follow the shortest path algorithm and transfer the data to its partner node in this manner the last sensor node will deliver the data to the data aggregator which is positioned there.

MIDDLE LEVEL OF OCEAN (SEA LEVEL)

In the middle level of ocean the Aquanodes (sensors nodes) which we deploy are attached with AUV’S and we will also position a data aggregator. These AUV’S sensors have two functioning one is to collect the data from the middle layer of ocean and send it to the data aggregator of middle layer. At this level Aquanodes will follow the same data communication method which is used at bottom level that is Cooperative Diversity. Second thing is to replace the discharge sensor or those sensors which are destroying due to any disaster occur.

At the bottom level if any sensor will destroy due to any disaster, then these autonomous vehicles will placed the sensors instead of that destroyed sensor. So due to these autonomous vehicles the reliability of our network will be remaining.”

OCEAN TOP LAYER (SEA LEVEL)

At zenith level of marine the Aquanodes or simply sensor nodes, the positioning of the nodes are done in the status of moving nodes and these follow shortest path approach for data transfer.

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As we are using the AUV, s at middle level, if any sensor will destroy at the top level then those AUV, s will drop one of the sensors which are not in the use means which is in the sleep mode there. So this will maintain the reliability of the network which we deploy in underwater.

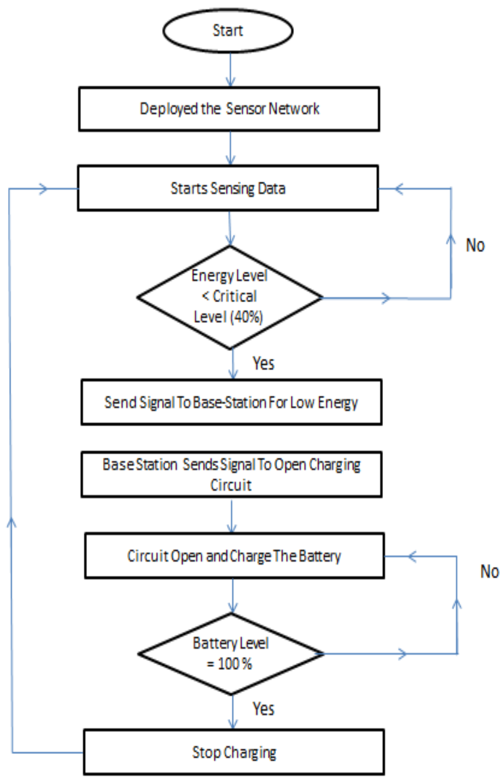

Figure 1 – DFD of the Presented Effective Model

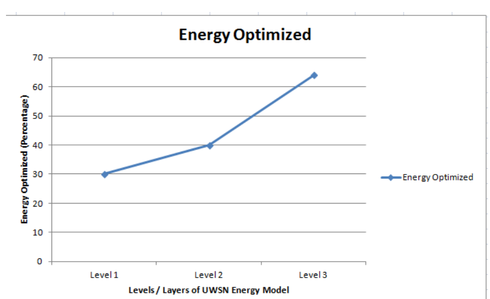

Figure 2 – Optimization of Energy in the Effective Model

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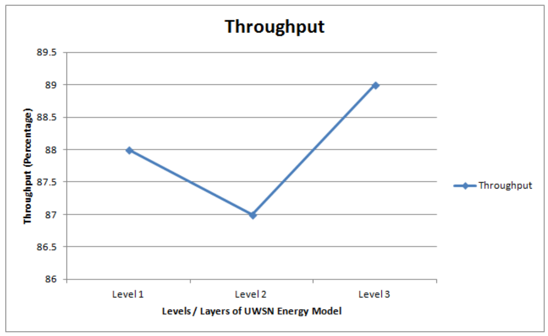

Figure 3 – Measured Effective Performance in the Proposed Algorithmic Approach

CONCLUSION AND SCOPE OF FUTURE WORK

Underwater Sensor Networks are more susceptible to the energy loss because of their frequent movement within the ocean. There are number of approaches available and devised by the researchers for energy optimization and harvesting, still this domain is under research. In the proposed research paper, a novel and effective approach for energy harvesting is presented and implemented which makes use of solar power and ocean waves for dynamic recharging and harvesting of energy. The proposed approach is effective in terms of higher lifetime and overall performance of the network.

In the research work and algorithm presented and implemented, the results are very effective and better than the greedy method. The proposed approach can be further enhanced using nature inspired algorithms which can give the global optimization results.

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