Link Quality Analysis based Method to Optimize Communication in Underwater Sensor Network

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Abstract: Underwater sensor network are affected by floating movement of nodes and limited energy of sensor nodes. In this paper, a link quality analysis based method is provided to identify the most effective neighbor and to improve the reliability of the communication in underwater sensor network. The proposed communication method has maintained the observation on line-of-sight for neighbor nodes and to define the analysis based on coverage, energy and fault features. The zone based analysis is done to identify the most effective next hop. The process is repeated to generate the effective route. The comparative results show that increase in network life.

Keywords: UNSN, Routing, Link Quality, Optimization

I. INTRODUCTION

An Underwater Sensor Network is specialized wireless network that is used in real time application with the inclusion of electromechanical components. These sensor nodes are defined with certain restrictions and specifications in terms of energy, power, sensing range, size etc. [1,2]. These sensors are small, with limited processing and computing resources and they are inexpensive. The architecture of sensor network is shown in figure 1.

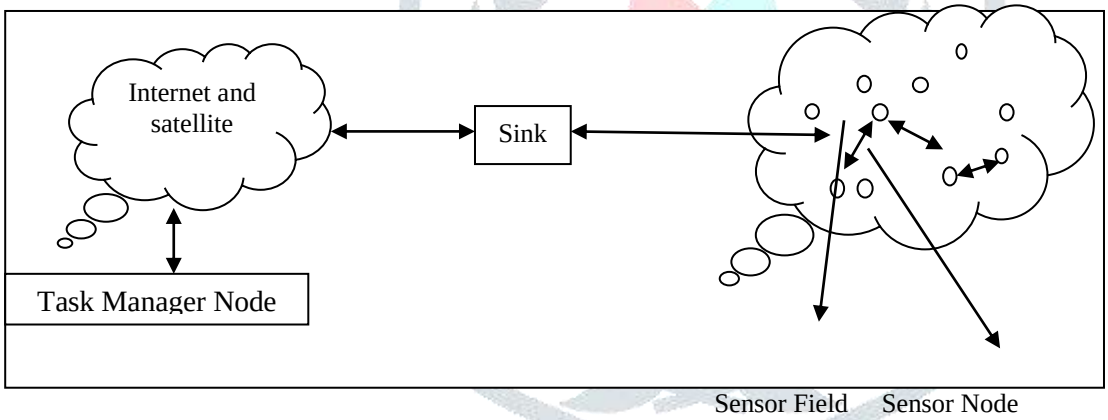

Figure 1: Underwater Sensor Network

The type of sensor also plays the crucial role. These sensors are based on the environmental conditions with the specification of different characteristics. These Characteristics include the sensing range specification, energy specification, energy consumption constraint, capability to take local decisions etc.

An Underwater Sensor Network is defined as the physical component that helps to extract the environmental feature in the form of signal and convert it in some quantized form such as analog or digital signal. These all kinds of signal specifications are based on the instrumental analysis performed by the attached microcontroller. The sensor device itself is not a signal component whereas it can be a fully functional device with the inclusion of different featured components such as I/O interface, memory constraint, processor, battery etc. The figure shows that the sensor is connected to some power source to activate the sensing device and this sensing device performs the location oriented search over the system. This kind of sensing unit is formed using sensor specification and the convertor. This converter will convert the analog signal to digital form. Once the signal is captured, the processing unit is attached to process the signal. This processing unit is having the various components in the form of processor and memory specification. Along with this, the transceiver is attached to perform the direct signal extraction for processing [1-6].

An Underwater Sensor Network is the small scale network generally distributed in limited geographical area based on the application requirement. Normally because of the smaller capabilities of sensors, this kind of network is composed under dense network architecture. These sensor nodes perform a multi hop communication to deliver the information to the controller end. The

optimization is required in this network under different aspects in terms of localization of nodes or in architectural form of network.

There are different kind of network architectures are available to provide the effective network localization. In the simplest form, the architecture is unstructured and having a dense and random placement of nodes. This kind of network architecture is comparatively costly and not energy effective. In the second form of network architecture, the nodes are placed in a defined pre planned form. In this structured architecture, the nodes are placed under the prejudgment of network requirements as well as communication requirement. This network architecture is considered as an intelligent network and improves the network life and throughput [1-8]. This localization aspect also includes the dynamic change while generating the network or after the network construction. These aspects include the clustering concept, area coverage, load balancing etc. Clustering is about to divide the network in smaller sub networks in which each sub network is controlled by a centralized controller called cluster head. This cluster head is responsible to manage the communication over the cluster. This clustering is here based on the various concepts including the load balancing. It means, a cluster should have effective number of nodes so that the load of the particular cluster head will not be increased. Another concept associated here is area coverage. Area coverage is considered as the node placement in such way, the maximum area will be covered over the network. It will provide the equalize distribution of nodes over the network will provide the improvement to the network. This kind of architecture is also able to identify the density estimation over the network will provide the reduction in communication failure. It will provide the improvement in terms of network life and network throughput [1-2].

II. RELATED WORK

Author [1] has presented a reliable routing protocol to improve the reliability of data transmission. The link specific evaluation was proposed by the author as Node by node channel evaluation model (NNCEM). The node pairs are evaluated to generate the cross layer analysis and to identify the node specific reference. Author [2] has proposed a hybrid adaptive routing protocol to handle the diversity in terms of data and communication parameters. The video streaming, voice communication and data quality evaluation was considered by the author while performing the communication in ocean sensor network. Author [3] analyzed the existing routing protocols for underwater sensor network with application and network specific challenges. The data transmission and communication parameters were configured for effective data delivery in shallow and deep water network. Author provided the comparative evaluation for sink mobility depth based routing protocol (SMDBRP) and aided efficient data gathering routing protocol (AEDGRP). Author [3] has presented a light weight depth based routing protocol to optimize the communication in underwater sensor network. The network capability utilization and energy node specific evaluation was analyzed to identify the effective forwarder node. Author [5] has provided a study on various routing protocols available for underwater sensor network. The technological aspects along with application specification are also described in this paper. Author [6] has provided a comparison on DBR (Depth Base Routing) and L2-ABF (Layer-by-Layer Angle Based Flooding) routing protocols for underwater sensor network. The acoustic channel and environment specific considerations are also observed while analyzing the performance of the protocols. Author [7] has proposed an (EAVARP) energy-aware and void-avoidable routing protocol to improve the data delivery for sensor network. The proposed protocol is defined under the layer specific and data feature specific features.

Author [8] has explored the challenges associated to opportunistic routing in underwater sensor network. Author also identified the potential, constraints, features and guideline of opportunistic routing respective to the environment and the scenario. The multihop propagation, neighbor discovery, technical aspects and the acoustic feature based route identification measures and methods were discussed by the author. Author [9] has proposed a new triangular matrix based routing protocol under the evaluation of link quality and path loss factors. The depth based analysis and the geometric constraints were also considered by the author. The protocol has evaluated the next effective hop based on Packet Reception Probability (PRP), Signal to Noise Ratio (SNR) and Link Quality Indication (LQI) parameters. The reliable forwarder identification method was proposed in this research to avoid the chances of failure. Author [10] has presented an energy effective routing method for clustered underwater sensor network. The model is defined with specification of architectural constraints of 3D underwater sensor network. The clustering method is defined based on data transmission, coverage and energy feature evaluation. Author [11] has improved the route in underwater sensor network with specification of 3D architecture and acoustic features evaluation. The strategy included in the routing protocol is analyzed with performance constraint regulation and to observe the energy and delay features for sensor nodes. Author [12] has proposed a robust energy-efficient adaptive (REAR) protocol to improve the communication in underwater sensor network. Author provided the evaluation of the mobile nodes in acoustic environment and to identify the weights for neighbor nodes. Author [13] has provided a study work on various routing protocols with various constraints of underwater sensor network. The protocol behavior, energy effectiveness, bandwidth utilization and the environmental behavior specific analysis were provided in this paper. Author [14] has proposed a method for data forwarding and neighbor prioritization to improve the communication in underwater sensor network. The baseline new lightweight energy aware opportunistic routing (EnOR) protocol is defined to balance the energy consumption and to identify the most effective intermediate neighbor.

III. RESEARCH METHODOLOGY

This research work is defined to handle the issues and features of underwater sensor network and to generate the effective communication path over the network. The architecture has utilized the limitations and restrictions of network and nodes in effective way to improve the network communication. The restrictions of the underwater sensor network include:

- The resources and capabilities of nodes and network are very less in terms of energy, sensing range etc.
- The energy consumption occur at each participation of node as forwarder, receiver or transmitter
- The failure can occur in case of non-coverage or the channel based communication failure.
- The absence of centralized controller, the node specific neighbor tracking is required.

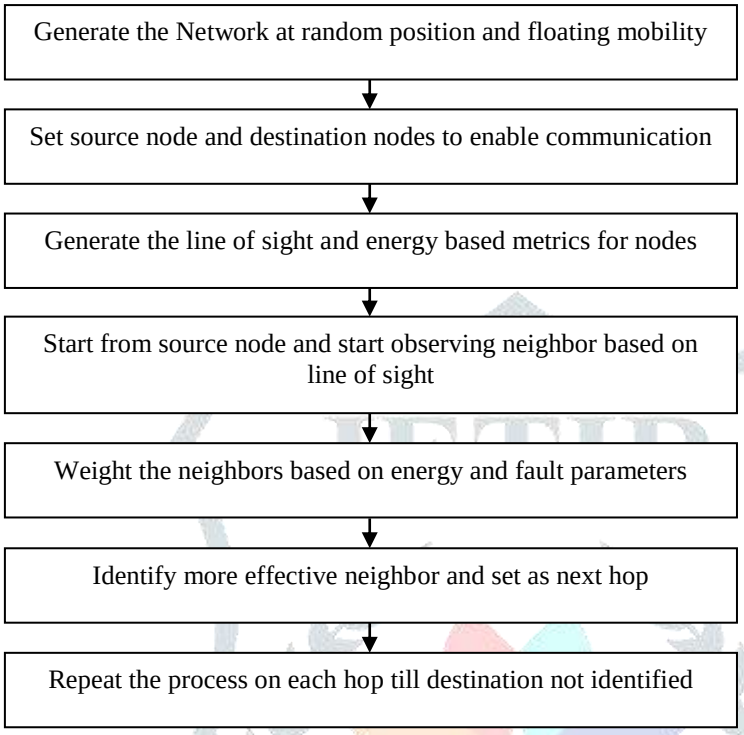

Figure 2: Proposed Communication Model

The proposed communication architecture is able to utilize the channel and communication features to improve the network communication and efforts. The method is able to utilize the restriction of the nodes and network in effective way. The neighbor list is maintained by each node to identify the next possible neighbor and the distance based estimation is performed respective to the destination node. The farest node in the neighbor list was identified to generate the most effective link to the neighbor node. The node specific evaluation is also done based on expected error rate and energy parameter. This process is repeated till the destination node occurs. The model for communication in the underwater sensor network is provided in figure 2

Figure 2 has defined the communication architecture to optimize the route formation for underwater sensor network. The communication architecture is defined with specification of random scenario with floating mobility. The nodes are individually defined with energy, fault probability and position specification. The initial observation at node level was done to generate the distance matrix and the energy based features. To begin the communication, the source and destination nodes are defined. The neighbor search is performed by setting the source as current node and the energy and fault parameter based analysis was performed. The process is repeated till the destination node not occurs. The greedy based analysis is performed at node level to identify the most effective neighbor node. The work is defined to reduce the energy consumption and to improve the packet communication over the network.

IV. RESULTS

In this research work, an improvement to existing energy based communication system is provided for underwater sensor network. The neighbor connectivity observation and error rate estimation is included to increase the communication effectiveness. In this section, the simulation results obtained for the work for a random scenario are provided. In this research work, a network is generated with random placement of nodes. The nodes are distributed randomly over the network with specification of random source and destination nodes. The nodes are distributed with specification of random scenario.

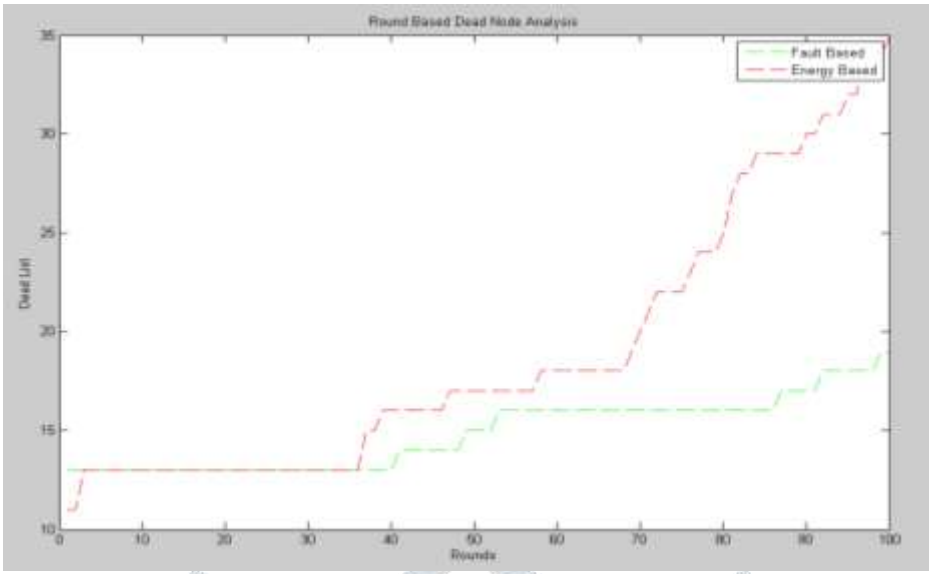

Figure 3: Dead Node Analysis

Here figure 3 is showing the comparative analysis of existing energy based and proposed fault approach in terms of dead node analysis. The results show that the number of dead nodes in case of existing approach is high whereas the number of dead nodes in proposed approach is low. It shows that the network life is improved.

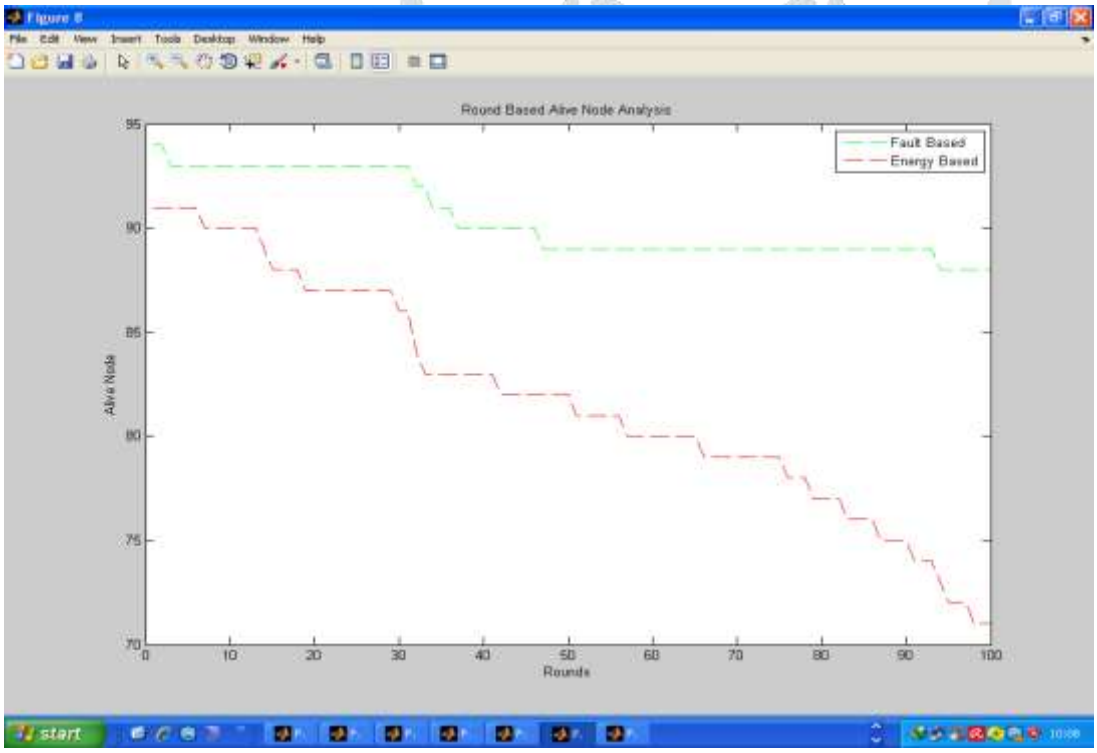

Figure 4: Alive Node Analysis

Figure 4 is showing the comparative analysis of existing energy based and proposed fault approach in terms of alive node analysis. The results show that the number of alive nodes in case of existing approach is low whereas the number of alive nodes in proposed approach is high.

IV. CONCLUSION

Underwater sensor network is a challenging and real time problem because of node and network level restrictions. The route formation and communication optimization is difficult in such network as there is no centralized controller and absence of the GPS system. The node level tracking is done by the neighbor nodes themselves. In this paper, an effective parameter based

method is defined to get the maximum benefit of available resources and features and to improve the network communication and life. The results identified that the proposed protocol has improved the network life and network communication.

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