Performance Evaluation of AFISH Algorithm for Energy Efficient Data communication in UWSN

S.A.KALAISELVAN[1], V.PARTHASARATHY[2]
[1]Research Scholar, Department of Computer Science and Engineering,
St.Peter's University, Avadi, Chennai, INDIA
[2]Professor & Dean, Department of Computer Science and Engineering,
Vel tech Multi tech DR.RR & SR Engineering College, Avadi, Chennai, INDIA
[1]kalaiselvanresearch@gmail.com,[2]sarathy.vp@gmail.com

Abstract: - Drastic growth of sensor network technology paves way to the socio economic applications in all aspects. Similarly introduction of new sensor for various parameters increases the scope for data collection and manipulation for useful inferences. In order to exploit largest unutilized resources vested with the ocean environment, the necessity arises for the researchers to find out the sensor network suitable for the monitoring of fish movements and to decide on the probable area for data communication in underwater. Main objective of the paper is to monitor and analyze the fish movement and behaviour in the underwater sensor networks by introducing the new algorithm called AFISH [ARTIFICIAL FISH] algorithm, which will study the movement and behaviour of fish in the water with certain parameters. The behaviour is observed with certain under water sensors placed along the Length, breadth and depth of earmarked area and with the help of data fusion the information is observed and manipulated to understand the data communication area and optimum time for the same. The simulation results show that the proposed AFISH algorithm for fish movement monitoring works effectively under certain presumed conditions.
.

Key-Words: - Underwater Communication; Fish movement Study; Acoustic Signal; Data communication.

1 Introduction

One third portion of the surface of earth is occupied by land and the remaining is occupied by water. Due to high pressure, vast in area and harshness of the underwater environment, the people entry to ocean is limited. Comparing with land, the human ideas and information about ocean is very less. In upcoming decades, a numerous number of researchers are interested nowadays in gathering data from ocean environment to analyze this kind of environments. To start a new way of communication in underwater it is introduced that an underwater acoustic sensor networks that are composed of a numerous of autonomous and self organizing characteristics based sensor nodes and which are scattered randomly in a particular distance with different depths in underwater environment. These sensor nodes will collect particular data shallow or deep water. The collected data is converted as acoustic waves and will pass it to sink nodes placed in the water surface. Underwater sensor nodes are also normal sensor nodes, equipped with acoustic modem which helps the node to communicate in underwater to onshore base station through radio waves.

2 Background Study

Here a brief comparative study is given about the existing approaches proposed in the earlier research for monitoring the fish movement in underwater environment. In order to find the fishes for fisheries catchment an FMMS[Fish Movement Monitoring System] is proposed in [1]. An efficient OEERP[Optimized Energy Efficient Routing Protocol] and AFISHS[Artificial Fish Swarm] Optimization algorithm is proposed for finding the shortest past in underwater sensor network in [2]. To minimize the travelling distance and travelling time a 3-dimensional fixed emplacement sensor field was deployed in the underwater in [3]. An adoptive push system [4] for data broadcasting, VAPR-[Void Aware Pressure Routing protocol [5], is used for sensing periodic based data using beacon nodes by the direction and hop counting information. Since nodes cannot communicate from the level of seabed directly to the nodes in the surface level and needs multi-hop based communication is proved in [6]. The reliability of the node communication, energy efficiency can be obtained by a novel Multi-path FEC approach combined with hamming code is proposed in [7]. A LOP-[Low Overhead Protocol] is proposed [8] for improving the efficiency of the UAN in-terms of throughput, PDR, e-2-e delay and control overhead. A MFBR-[Modified Focused Beam Routing] is proposed in [9] improved the efficiency of the network than MFEC. The exact calculation for path loss models applied for indoor propagation which is investigated in multi-wall configuration is discussed in [10]. In [11], the sensor nodes are deployed in layer wise and analyze the output from the sensor nodes to learn about the layers in the underwater environment.

Various protocols like VBF, DBR, H2-DAB and QELAR are discussed [12] and the performance of the underwater is analyzed in-terms of localization, energy saving and delay. By deploying the nodes in 3D topology in the underwater to construct a logical 3D USN [13], and collect the data from sensor nodes within the 3D zone and the performance metrics are analyzed in the network. The main problem is how to efficiently collect data from sensor nodes within a 3-D ZOR while those sensor nodes are usually in sleep mode for a long period. A Priority-MAC based ad-hoc routing protocol is used in UWSNs and investigate the energy efficiency of the network with PDR is discussed in [14]. The depth information of the nodes in UWSN is analyzed by a new routing protocol in [15], also the overall energy consumption is balanced in the network. Since GPS based location estimation is too expensive, an effecting greedy location finding algorithm is combined with a routing protocol is used in UWSN to handle the mobility of the nodes in the water [16]. AEEDBR-[Advanced Energy Efficient Depth Based Routing Protocol] is proposed in UWSN to find an optimized route in the network [17].

But in this paper, a novel system is applied to place the nodes in the network to create a topology like a 3D-Grid manner, where the nodes are deployed in a particular distance, depth and particular width among the nodes to communicate perfectly to trace the fish movement in the network.

3 Proposed Approach

A number of sensor nodes are placed in a scaled area, with a predefined distance, depth and width among the nodes. It is easy to compute and calculate the total distance from the source node where the monitoring starts and the destination node which is the last node is placed in the final depth of the area. It is assumed that the sensor nodes can sense a specific frequency based signals and transmit to the BS where the BS is a well configured node which can communicate at any time to any number of nodes where each node has its own ID.

Fig. 1: Sensing Device Injecting into Fish

The A Fish injected sensing device is [shown in Figure-1] deployed in the monitoring area which is chosen already and when the fish moves nearer to the sensor node, the node can sense the fish and pass a message to the BS.

The experimental fish should be a Male fish which can swim fast than the female fish in certain period of time. Since the fish moves continuously within the area, the deployed sensor nodes in that area can sense the signal from sensing device injected in the fish, send message to BS repeatedly by all the sensor nodes, which ever the sensor node can sense the fish. Using the sensed data gathered in BS, a time effective, less distance base route will be elected as a permanent route for data communication in the UWSN by AFISH algorithm.

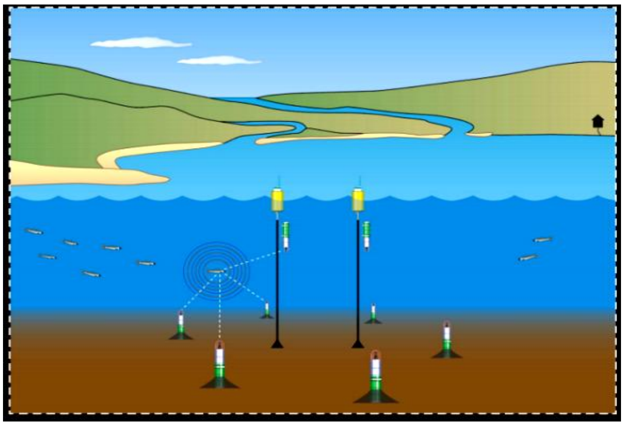

Fig. 2: Optimal Route Selection using Fish Movement Analysis

The same manner, an iterative process is conducted by deploying sensing device multiple number of fishes and record the route in different time intervals and an optimal route will be elected by using AFISH algorithm. An example optimized route selection is depicted clearly in Figure-2. The network has numerous number of nodes deployed in a particular manner is depicted in the following Figure-3. The top node is considered as BS available in the surface and the other nodes are deployed inside the water in level by level with an approximate offset distance among the nodes.

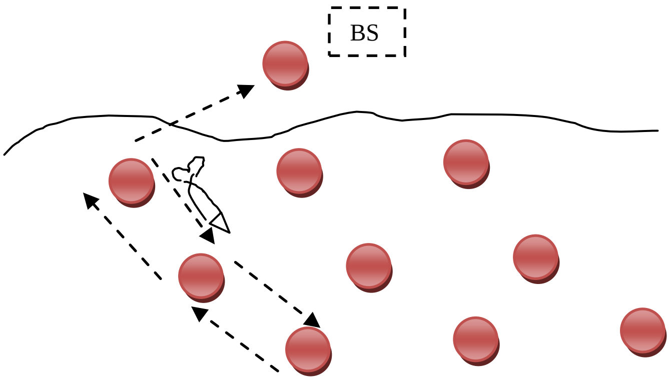

Figure. 3: Proposed Architecture

Let G be a network, A is the Area, N is the number of sensor nodes deployed is represented in a mathematical model is given in the form of an Algorithm.

AFISH Algorithm ( )

{

- $G = A\ where$
  $A = M x\ N\ sized\ underwater\ area,$
  $N = \{n\_1, n\_2, \dots\dots, n\_N\}$
- $for\ i = 1\ to\ M$
- $for\ j = 1\ to\ N$
- $[Row, column] = deploy(n\_i)$
- $end\ j$
- $end\ i$
- $For\ P = 1\ to\ 100\ //\ optimization$
- $let\ fish_P\ is\ the\ fish\ where\ the\ sensing\ device\ injected$
- $for\ i = 1\ \langle o\ M\ //\ row\ wise\ area$
- $for\ j = 1\ to\ N\ //\ column\ wise\ area$
- $If\ (n\_i \leftarrow signal(fish)\ then\ BS \leftarrow msg(n\_i)$
- $(rotuing)\_TABLE = append((routing)\_TABLE, id(n\_i))$
- $(time)\_Table = append((time)\_TABLE, time)$
- $(distance)\_TABLE = append\ ((distance)\_TABLE, distance)$
- $end\ j$
- $end\ i$
- $End\ P$
- $Optimization((rotuing)_{TABLE}, (time)_{TABLE}, (distance)\_TABLE)$
- $Display\ the\ optimized\ route$
- $Initialize\ the\ data\ transmission\ in\ the\ best\ path$

}

4 Simulation Settings

The above AFISH algorithm can be developed in any programming language and the route optimization can be obtained using fish movement and behaviour. In this paper the Network Simulator tool is used to simulate the proposed approach. The front end coding is developed using TCL language and the routing of DSR can be configure using .cc coding. The NS-2.34 version of the NS2 software is taken for simulation with certain parameter configuration and it is shown in the following Table-1.

Parameter	Level
Area	1000m x 1000m
Speed	1 to 15 m/s
Radio Propagation Model	Two-ray ground reflection
Radio Range	250 m
Number of Nodes	20 to 1000
MAC	802.11

Application	CBR, 100 to 500
Packet size	50
Simulation Time	100 s
Placement	In Grid Manner

Table-1: Simulation Settings

The number of simulation can be obtained repeatedly by changing the number of sensor nodes deployed in the network region as 20, 40, 60, 80 and 100 nodes. In every iteration, the route is elected with shortest distance with minimal time. For optimization, all the route, distance and time based data will be compared and optimized route will be chosen. Where this route is the shortest for data communication and travelled in minimal time.

5 Results and Discussion

The proposed AFISH algorithm is implemented and simulated in Network Simulator-2 software, and the performance of the network is investigated by multi-round simulation is simulated. The performance is evaluated by the metrics throughput, energy, delay and the best path obtained by the routing strategy applied in the UWSN.

It is assumed that a random node A is elected as source node and the leaf node is elected as the destination node and using CBR traffic pattern the data packet is transmitted with the help of the scheduler integrated in the NS2 software. The following figures show the results obtained in the simulation.

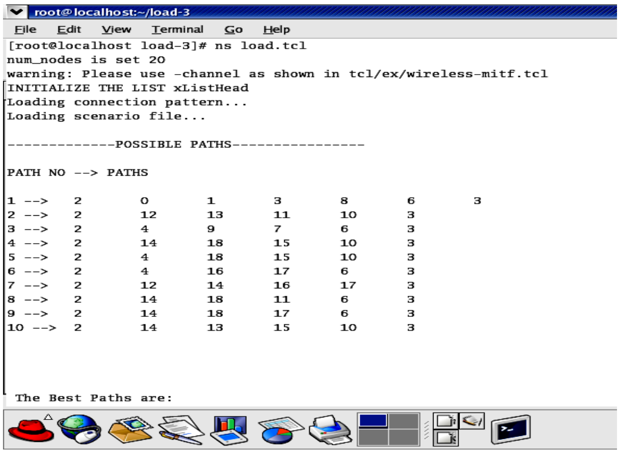

Fig4a: Traversed Path from node-2 to node-3

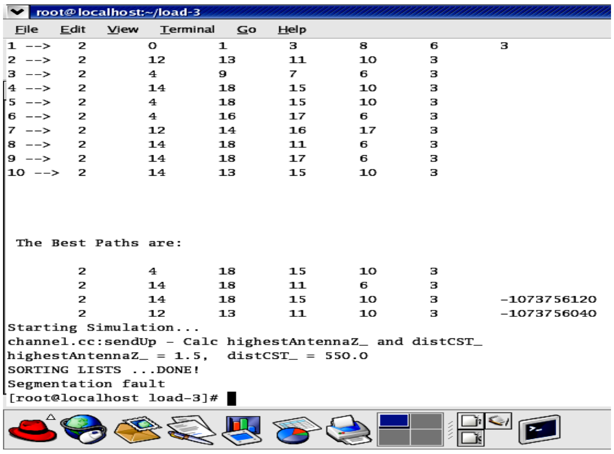

Fig4b: Best Paths from node-2 to node-3

The node-2 is elected as source node and node-3 is elected as destination node, and the fish movement is monitored and 10 numbers of non-repeating paths are recorded. Within this 10 path, only three paths are selected as best paths and the right path is selected according to the distance, energy taken to traverse and time taken for traversing in the path and is shown if Figure-4b..The performance of the proposed approach is evaluated by deploying various number of nodes in the network as 20, 40, 60 80 and 100 and the performance metrics are compared and shown in the following Figures.

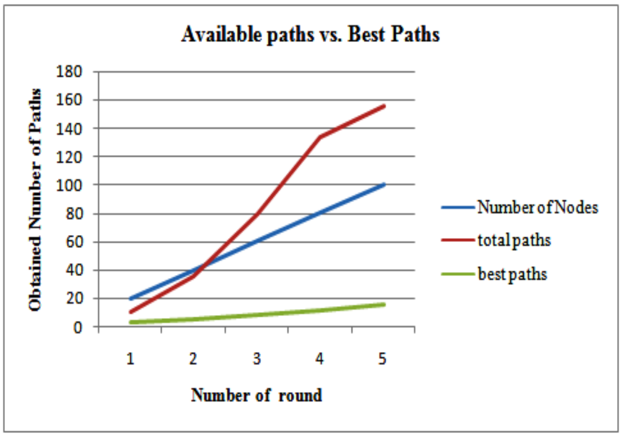

Figure-5: Best Path vs. Obtained Paths

When the nodes are transmitting data packets from source node to the leaf nodes through a best optimized path among several possible paths in the network from source node to destination node and the best paths obtained from available path is shown in Figure-5 clearly. During the data transmission among the nodes, the nodes lose some amount of energy for transmitting and receiving the data packets. The amount of energy spent by the network is the sum of the energy spent by entire nodes in the network and the remaining energy is computed.

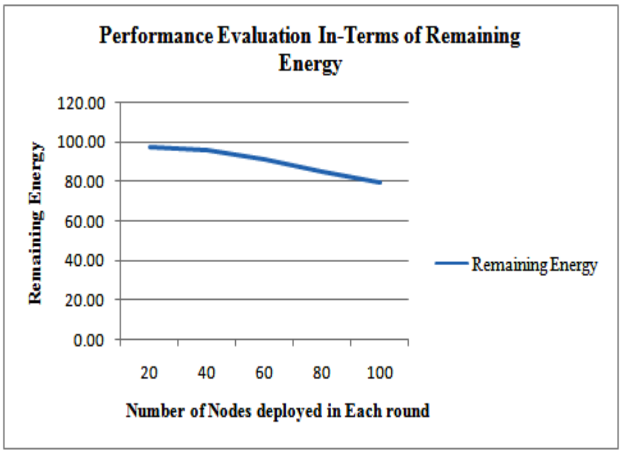

Figure. 6: Performance Evaluation in terms of Energy

The complete energy remains in the network is depicted clearly in Figure-6. The remaining energy is 97.23% for 20 nodes , 95.65% for 40 nodes, 90.99% for 60 nodes, 84.34% for 80 nodes and 79.12% for 100 nodes respectively in the network.

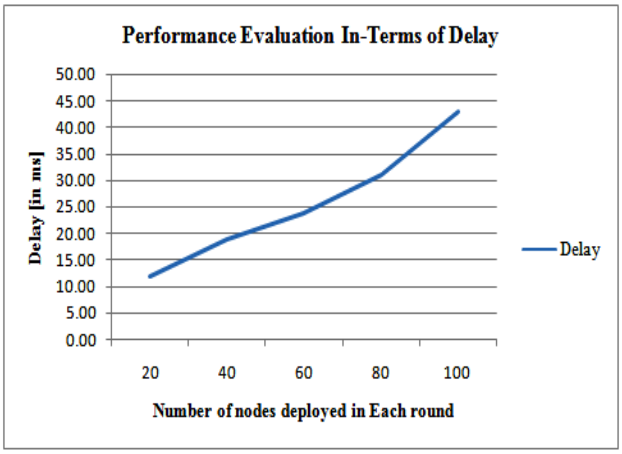

Figure. 7: Performance Evaluation in terms of Delay

The total time taken to travel in a path is predefined, when the time exceeds then it is called delay and the delay of the network is computed by the sum of the total delay for entire path in the network. The delay time 12, 19, 24, 31 and 43 milliseconds taken for 20, 40, 60, 80 and 100 nodes respectively in the network.

6 Conclusion

From the simulation results it is clear that the fish movement analysis is one of the main process in underwater sensor network to obtain a best routing path for data communication with the shortest and minimal time. From the results it can be understand that the energy, delay is utilized and consumed in an efficient manner is completely depends on the topology constructed and the routing mechanism used. The AFISH algorithm provides best path for data communication between the source and destination nodes. And the overall energy saved and best path is discovered in underwater for the data communication is more effective.

References:

[1]. V.Parthasarathy, S.A.Kalaiselvan, S.Hemalatha, G.Venkata Swaroop, "Performance Evaluation of FMMS using Underwater Sensor Network", ICBEC 2014: October 29-30, San Diego, USA, Elsevier, 2014.

[2]. S.A.Kalaiselvan, V.Parthasarathy, "An Energy-Efficient Routing Protocol for UASN by AFISHS Optimization Algorithm", International Journal of Applied Engineering Research, Vol. 9 Number(24), 2014.

[3]. Stanley Barr, Jie Wang, Benyuan Liu, "An Efficient Method for Constructing Underwater Sensor Barriers", Journal Of Communications, Vol. 6, No. 5, August 2011.

[4]. K.Christidis, P.Nicopolitidis, G.I.Papadimitriou, P.G.Sarigiannidis, "A. S.Pomportsis, Utilizing Locality of Demand for Lower Response Times in Underwater Data Broadcasting", Vehicular Technology Conference (VTC Spring), IEEE 73rd , 2011.

[5]. Youngtae Noh, Uichin Lee, Paul Wang, Brian Sung Chul Choi, and Mario Gerla, "VAPR: Void Aware Pressure Routing for Underwater Sensor Networks", Mobile Computing, IEEE Transactions on (Volume:12 , Issue: 5), May 2013.

[6]. Muhammad Ayazn, ImranBaig, AzweenAbdullah, IbrahimaFaye, "A survey on routing techniques in underwater wireless sensor networks", Journal of Network and Computer Applications, Volume 34, Issue 6, November 2011, Pages 1908–1927, June 2011.

[7]. JunfengXu, Keqiu Li, and Geyong Min, "Reliable and Energy-Efficient Multipath

Communications in Underwater Sensor Networks", IEEE Transactions On Parallel And Distributed Systems, Vol. 23, NO. 7, July 2012.

[8]. RonyHasinurRahman, Craig Benson, Frank Jiang, and Michael Frater, "LOARP: A Low Overhead Routing Protocol for Underwater Acoustic Sensor Networks", Journal Of Networks, Vol. 8, No. 2, February 2013.

[9]. Kamesh M#1, Karthika S*2, "Performance Improvement in Underwater Wireless Sensor Networks Using MFBR Technique with Error", proceedings of International Journal of Advanced and Innovative Research, IJAIR 2.3 (2013): 602-606.

[10]. Ananya Sarkar1, Subhasish Majumdar2, ParthaPratim Bhattacharya3, "Path Loss Estimation for a Wireless Sensor Network for Application in Ship", IJCSMC, Vol. 2, Issue. 6, June 2013.

[11]. Jaime Lloret, "Underwater Sensor Nodes and Networks", Sensors 2013, 13, 11782-11796; doi:10.3390/s130911782.

[12]. S. Ahmed1, I. U. Khan1, M. B. Rasheed1, M. Ilahi1, R. D. Khan2, S. H. Bouk1, N. Javaid1, "Comparative Analysis of Routing Protocols for Under Water Wireless Sensor Networks", Ahmed et al.,2013.

[13]. Yuh-Shyan Chen and Yun-Wei Lin, "Mobicast Routing Protocol for Underwater Sensor Networks", IEEE Sensors Journal, VOL. 13, NO. 2, February 2013.

[14].]. Md.Ashraf Uddin, Md.Mamun, Md.Rashid, Md.MustafizurRahman, "Priority Metric based Ad Hoc Routing for Underwater Sensor Network", IJCNIS Vol. 5, No. 12, October 2013.

[15]. Reza Javidan, HamidehRafiee, "A New Energy Efficient and Depth based Routing Protocol for Underwater Sensor Networks", British Journal of Science, Vol. 8 (1), January 2013.

[16]. Mohammad Taghikheirabadi, Dr.Mohd.MurtadhaMohamad, "An Efficient Routing Protocol And Void Avoidance Algorithm For Underwater Sensor Networks, Wireless Algorithms Systems and Applications", Lecture Notes in Computer Science Volume 5682, 2009, pp 305-314.

[17]. F. Najeeb1, Z. A. Khan2, U. Qasim3, Z. Najam1, J. Ikram1, S. H. Ahmed4, M. J. Ashraf1, N. Javaid1, "A New Advanced Energy Efficient Routing Protocol for UWSNs", Journal of Basic and Applied Scientific Research 4(2)43-53, 2014.