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Acoustic Environment Wireless Network Optimization by Frog Algorithm

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Abstract- Within underwater acoustic sensor networks (UWASN), achieving energy-efficient data transmission presents a formidable challenge. This is attributed to disruptions in acoustic transmission stemming from heightened noise levels, exceptionally prolonged propagation delays, an elevated bit error rate, restricted bandwidth capabilities, and interference. A paramount concern for UWASN researchers revolves around extending the longevity of data transmission. The intricate process of transferring data from a source node to a destination node in UWASN remains a complex and pivotal focus for researchers. Proposed model AWNOFA is a network clustering approach to reduce the energy losses during communication. Use of memeplex concept in Frog Algorithm has increase the work efficiency. Selected nodes were used in network as cluster center to pass packets to the base station. It was obtained that results are better than other existing methods of acoustic network optimization algorithm on different parameters.

Keywords- UWSN, Communication, Routing, Energy Optimization, Genetic Algorithm.

I. INTRODUCTION

Securing Underwater Wireless communication Networks (UWCNs) area unit deep-seated by sensors and Autonomous Underwater Vehicles (AUVs) that move to perform specific applications like underwater observance Coordination and sharing of data between sensors and AUVs create the supply of security difficult[1]. The aquatic surroundings is especially liable to malicious attacks thanks to the high bit error rates, giant and variable propagation delays, and low information measure of acoustic channels. Achieving reliable repose vehicle and sensor-AUV communication is very troublesome thanks to the quality of AUVs and therefore the movement of sensors with water currents. The distinctive characteristics of the underwater acoustic channel, and therefore the variations between underwater detector networks and their ground primarily based counterparts need the event of economical and reliable security mechanisms [2].

Underwater sensor networks nodes are not static like ground-based sensor networks nodes. Instead, they move due to different activities and circumstances of underwater environment, usually 2-3m/sec with water currents. Sensed data is meaningful only when localization is involved. Another major issue that is affecting underwater sensor networks is energy saving [3]. Because of nodes mobility, the majority of offered energy competent protocols become inappropriate for underwater sensor networks. Different protocols regarding land-based sensor networks are, for example, Directed Diffusion, Gradient, Rumor routing, TTDD, and SPIN. However, because of mobility and rapid change in network topology these existing grounds based routing protocols cannot perform efficiently in underwater environment [4]. Optimal packet size is depending on protocol characteristic like offered load and bit error rate. Poor packet size selection decreases the performance of the network throughput efficiency, latency, and resource utilization and energy consumption in multihop underwater networks can be greatly improved by a using optimum packet size [5, 6]. To improve the better utilization of the available resources in underwater environment considering the energy and life time of network is discussed in detail in this paper. Balancing of energy consumption is carried out in underwater environment using the proposed techniques.

II. RELATED WORK

In [7] paper offers the newest analysis on the available evidences by reviewing studies in the past five years on various aspects that support network activities and applications in AIASNO environments. This work was motivated by the need for robust and flexible solutions that can satisfy the requirements for the rapid development of the underwater wireless sensor networks. This paper identifies the key requirements for achieving essential services as well as common platforms for ACOUSTIC. It also contributes a taxonomy of the critical elements in ACOUSTICs by devising a classification on architectural elements, communications, routing protocol and standards, security, and applications of ACOUSTICS.

A “reliable multipath energy-efficient routing protocol (RMEER)” is presented in [8]. This research work targets to enhance the network lifetime and set an optimal route to deliver the information to the desired target. The whole network is divided into five different and equal layers. The final destination node is placed at the top of the water surface, and static powerful carriers are deployed in the remaining layers. The last layer of the network contains ordinary sensor nodes. The multipath data routing mechanism is followed to deliver the information. In order to improve the packet delivery ratio multi sinks with the multipath disjoint algorithm are used. In this algorithm, if any node dies, then an alternate route selection bypasses the died node route [9]. The data forwarding process is defined by a routing table. A hello packet is sent by the courier node; after receiving this packet, every source node updates its routing table. This table contains the residual energy, link quality, and node ID. By analyzing all these parameters, an optimal forwarder node is selected for the data transmission towards the sink.

In [10], cooperation and multihop energy-efficient routing schemes are introduced for UA-WSNs. The information is generated by the nodes and directs this information towards the sinks through a multihop algorithm. To enhance the reliability of the network, a cooperation scheme is introduced to the one-hop communication. The data forwarding stage is accomplished in two phases. In the first phase, the forwarder node receives the information, and in the second phase, along with the forwarder node, one relay node is set to transmit the data. When both forwarders receive the information, then MRC technique is used which merges these two packets to make one reliable packet. To find the relative distance between nodes, the RSS algorithm is used. The outcomes of the proposed scheme show the best responses in terms of energy and stability of the network.

The fuzzy vector technique is determined in [11] which copes with the delay minimization and Frogtery life issues. This is an advanced version in which fuzzy logic technique (FLT) is utilized. The source generates information and then directs it towards the sink through a multihop mechanism and considers the maximum residual energy for data advancement. The best forwarder selection depends on the residual energy along with the node position. When the data packet generated by the source is broadcasted, all its neighbors receive the packet. Amongst all neighbors, one optimal node is chosen to deliver data to the next node. The residual energy of the selected node should be maximum so that it does not die soon and the position of this node should be minimum to sink node. The experimental results show the best responses in terms of fast data transmission and the network have maximum alive nodes.

III. PROPOSED METHODOLOGY

Acoustic Wireless Network need communication system that reduces the energy uses. For this clustering of nodes plays an important role. But as water waves shift nodes position hence dynamic approach is required that not ned any guidance. This paper has developed a AWNOFA (Acoustic wireless Network optimization by Frog algorithm) model to cluster Acoustic network nodes. Fig. 1 shows various steps of clustering and Table 1 list different set of notations used in this paper.

1. Develop ACOUSTIC Environment

Develop an V volume under water, place N number of nodes present in the region. Relegate their starting energy level before transmitting and getting any bundles. Energy utilization per unit node is required to be evaluate [13].

The transmission energy (E_{Tx}) and accepting energy (E_{Rx}) can be processed for a packet of length L bit, d the space among source and next/base/cluster node,.

The model to estimate the minimum transmission power in underwater acoustic communication is adopted based on themodel in [19], [20]. Denote P_0 as the minimum received power to successful receive a packet. Let $U(d)$ be the attenuation of transmitting underwater acoustic signals between twonodes with the distance of d . Then, the minimum transmission power is [30]

$$P = P_0 \cdot U(d)$$

where

$$U(d) = (1000xd)^m[\gamma(f)]^d$$

Here, m is the environmental coefficient (where we take m D 1:5 for shallow water acoustic channels) and $\gamma(f)$ is the absorption coefficient under carrier frequency f .We often use
the Thorp's formula to formulate (f), i.e.,

$$10log_{10}\gamma(f) = \frac{0.11f^2}{1+f^2} + \frac{44f^2}{4100+f^2} + 2.75 \times 10^{-4}f^2 + 0.003$$

The optimal choice of f is based on the empirical formula
below [30]:

$$f_{opt} = \left(\frac{200}{d}\right)^{2/3}$$

If cooperative nodes participate in the DCC transmissions,
the total energy consumption of a transmission is the sum of
the energy consumption of node i, node i + 1, and the corre-
sponding cooperative node. The formula for calculating the
total energy consumption for transmitting a packet, denoted
as E, is

$$E = P_o \frac{U(d_{i,i+1}) + \delta \times U(d_{c,i+1})}{1+\delta} \times T$$

where $U(d_{i,i+1})$ and $U(d_{c,i+1})$ are the underwater sound attenuation between node i and node i + 1 and between the cooperative node and node i + 1, respectively, T is the transmission time of node i, and δ is a binary indicator to imply if DCC is needed, i.e.,

$$\delta = \begin{cases} 0, & d_{i,i+1} < r_{max}\ for\ non\ DCC\ cooperation \\ 1, & d_{i,i+1} > r_{max} for\ DCC\ cooperation \end{cases}$$

where r_{max} is the maximum distance between two nodes to
determine if a cooperation node is needed for achieving the
DCC transmission [14].

2. Estimate K Cluster

Find number of cluster in the volume. Where r is range of devices to transmit [7].

$$K = \frac{3M^3}{4\pi r^3}$$

3. Generate Frog

The cluster center devices set is made up of chromosomes, and each chromosome is a possible FROG. So a FROG is a vector with n items, where n is the number of columns in the CD. The heart of each FROG is a group of gadgets that work together. So, if b is the number of

F←FROG_Population(p, K)----------Eq. 2

4. FROG Fitness Function

Each FROG was ranked by how far it was. So the health number is used to judge the distance run. A group of FROG-based gadgets were found underwater. FROGs cluster center devices figure out the fitness value by adding up how much energy it takes to send one message from each sensor device to the base station.

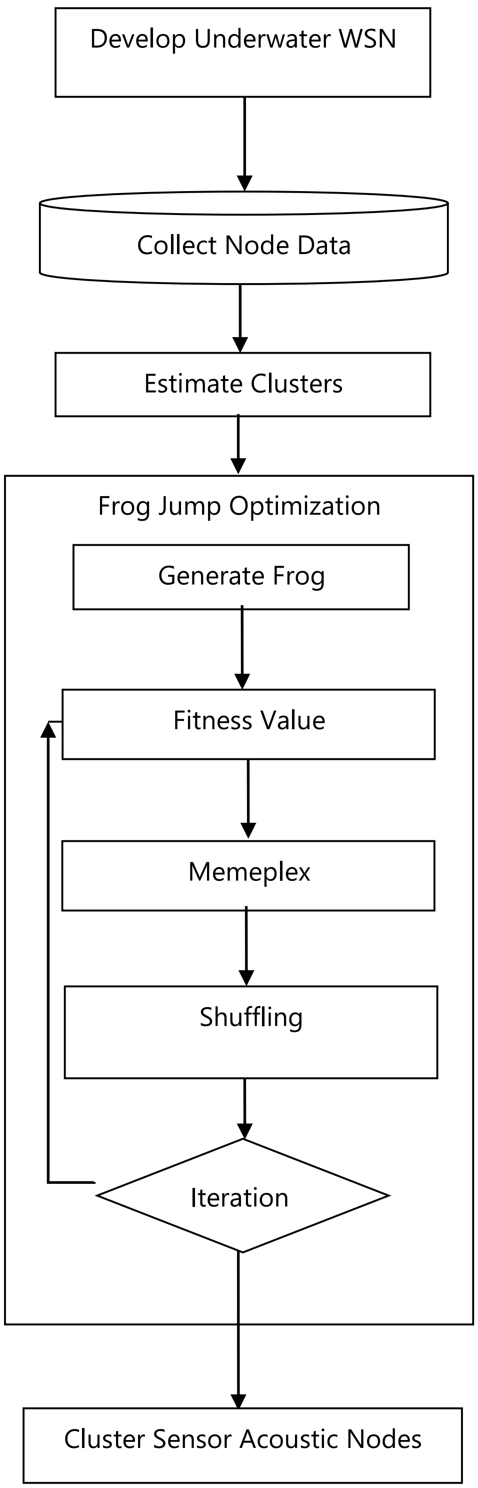

Fig. 2 Block diagram of proposed AWNOFA model.

5. Memeplex

Estimate the fitness value of each frog where accuracy of intrusion detection were sort in descending order. After sorting some set of frogs were cluster which is term as memeplex. Hence whole population Pf is divide into g cluster where each memeplex have t number of frog. So M = g x t.

6. Shuffling

In this step of genetic algorithm crossover of the algorithm was done by selecting one best parent in memeplex. So as per fitness value crossover with other set of frogs were perform. So selection of this common parent depends on fitness value. Here best fitness values frog act as common parent in all crossover operation in a memeplex. So other set of chromosome undergoes crossover by randomly replacing a feature presence or absence status as per common parent frog set. So if best set of Frog is {f_1^0, f_2^0, f_3^1, f_4^1.............f_n^0} and random feature position is three than status of third feature in other frog is set as presence. Seletion of position and umber of position s are random.

7. Update FROG Population

The fitness value of these FROG was further assessed by testing with their parent FROG. If the kid FROG exhibits superior values, the parent will be eliminated; otherwise, the parent will persist. If the maximum iteration steps are reached, go to the filter feature block; otherwise, assess the fitness value of each FROG.

9. Cluster WSN Devices

After each cycle is completed, the best FROG is determined from the most recently updated population. In order to obtain the cluster center devices within a Wireless Sensor Network (WSN). Once devices are clustered, the process of transmitting sensor data transmission commences. The transmission of data persists for a limited number of iterations, during which the cluster center is updated based on the new positions and energy values of the devices.

IV. EXPERIMENT AND RESULT

The suggested model for the acoustic WSN was implemented using the MATLAB platform. The experimental results were compared with the current model of WSN energy optimization, namely the ECRKQ model [12]. The hardware arrangement utilized for the experimental work consists of a configuration including 4GB of RAM and an Intel I3 CPU.

Results

Table 1 Comparison of acoustic WSN packets counts.

Volume x Nodes	ECRQ	AWNOFA
100mx120	2481	5493
150mx120	1014	2614
200mx120	1103	1793
250mx100	437	917
300mx100	139	814

Table 1 shows acoustic WSN packets counts of proposed model AWNOFA is high as compared to previous model. It was found that use of frog leaping algorithm clustering of nodes get improved and energy utilization get optimized

Table 2 Comparison of acoustic WSN Rounds counts.

Volume x Nodes	ECRQ	AWNOFA
100mx100	235	743
150mx100	72	153
200mx100	201	743
250mx120	24	139
300mx120	30	88

Total number of rounds count by the comparing approaches is shown in Table 2. It was found that use of clustering approach has improved the node energy life. Further it was found that model has increases the work round count by 69% as compared to previous model.

Table 3 Comparison of acoustic WSN first node discharge Rounds counts.

Volume x Nodes	ECRQ	AWNOFA
100mx100	4	14
150mx100	2	11
200mx100	2	8
250mx120	1	7
300mx120	1	5

Table 1 shows acoustic WSN network first node loss proposed model AWNOFA is high as compared to previous model. It was found that use of frog leaping algorithm clustering of nodes get improved and energy utilization get optimized.

Table 4 Comparison of acoustic WSN clustering algorithm time (seconds).

Volume x Nodes	ECRQ	AWNOFA
100mx100	0.166	0.0226
150mx100	0.251	0.0499
200mx100	0.1773	0.0174
250mx120	0.4212	0.0584
300mx120		

Execution time of clustering approach of the comparing models is shown in Table 4. It was found that use of clustering approach time of proposed model is reduces.

V. CONCLUSION

Wireless network brings ease of communication in unfavorable environments. Under water communication, study depends on such wireless networks. This paper has increases the network life by optimizing clustering approach. Frog leaping algorithm reduces the communication cost and increases the battery utilization Experiment was done different Environment and result shows that proposed model has increases the work performance. In future scholar can perform same experiment in under coal mines.

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