AN EFFICIENT MULTIHOPT IMPROVED ENERGY LEACH FOR UNDERWATER WIRELESS SENSOR NETWORK

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ABSTRACT

With the development and implementation of marine strategies in numerous countries, it's far of exquisite significance to gather marine facts via the usage of underwater acoustic sensor networks (UWA-SNs). due to the problems in charging or changing batteries, a way to prolong the lifetime of underwater sensor nodes is one of the key issues to be solved. To challenge this issue, Multihop correspondence in submerged acoustic organizations is a promising solution Grouping has been demonstrated to be perhaps the best procedure to save the energy of WSNs. LEACH (low energy adaptive clustering hierarchy)convention is quite possibly the most central works of WSN clustering. In this exploration, a novel methodology, Multihop Improved Energy(MH-IE) LEACH, Energy Efficient K-Means Clustering algorithm (MH- EKMC) is presented and created. The goal of this research is to produce simulation results that would show the exhibitions of the proposed protocol for a given metric such as Network lifetime, No of dead nodes per round, and total energy consumption.

Keywords: LEACH, K – Means, Multihop, Network Lifetime, Acoustic Communication, MH-IE.

I. INTRODUCTION

UNDERWATER remote sensor organization (UWSN) is a unique sort of remote sensor organization, which is made out of underwater acoustic sensor nods. UWSNs are conveyed in an underwater or sea-going climate and are equipped for checking close by environmental factors. They address the answer for various applications, for example, ongoing war observing, finding securing positions and lowered wrecks, oceanographic information assortment, fiasco anticipation, and so on. Underwater sensor nodes are little gadgets with compelled energy and little memory. In addition, these nodes utilize acoustic signals that can venture out to a longer distance than radio waves because of lower recurrence. Consequently, dissimilar to conventional sensor organizations, sensors in UWSNs burn-through additional energy because of the acoustic innovation utilized in underwater correspondences. To challenge this issue, Multihop correspondence in underwater acoustic organizations is a promising arrangement. In this examination, a novel methodology, Multihop Improved Energy LEACH, Energy Efficient K-Means Clustering algorithm (MH- EKMC) is presented and created. The objective of this examination is to create reenactment results that would show the presentations of the proposed convention for a given measured, for example, Network lifetime, the principal contributions of this paper are as follows: K-Means [1] is one of the handiest unsupervised studying algorithms that resolve the famous clustering

Data aggregation is one of the significant correspondence approaches in which numerous sources are sending information to the single sink as demonstrated in figure [1]. High thickness, low stream, low energy limit, furthermore, a distant climate. The last two attributes have made energy a significant requirement since the sensor batteries are by and large not battery-powered. To expand the lifetime of a remote sensor organization while guaranteeing the three fundamental assignments of sensor nodes: catch, handling, and sending of information, we should monitor the energy of sensor nodes. Among these three assignments is sending information or correspondence is the undertaking that consumes a lot of energy LEACH is a progressive convention where most
nodes sends the information to cluster heads, and the cluster heads total and pack the information and forward it to the base station.

II. MULTI HOP UNDERWATER WIRELESS SENSOR NETWORK

In this paper, we don't forget a UWA-SN such as a sink node placed on the ocean surface and a couple of underwater sensor nodes, a good way to be separated into several clusters thru a clustering set of rules. Within every cluster, the cluster head will first collect the records of each sensor node within the cluster. Then, the cluster head will be forward the accumulated statistics to the surface sink node via multi-hop transmissions demonstrated in figure[2].

III. RELATED WORK

In terms of energy stability studies in UWA-SNs, in [3], every sensor node is ready to periodically switch from the wake-up mode to the sleep mode to reduce power consumption when a sensor node is idle. The CH nodes are selected in step with the strength threshold information extensive-forged among the underwater nodes and then the non-CH nodes hook up with the CH node having the strongest signal strength. The authors in [4] used Bayesian junk mail filtering [5] to pick out cluster heads primarily based on the residual power and node spacing. The cluster heads then transmit records to the sink within the multi-hop mode. but, the multi-hop transmission is handiest carried out amongst cluster heads in this scheme, for this reason, main to the power holes problem. In [6], the authors implemented the Q-studying algorithm to pick out the high-quality course (which incurs the highest praise) for multi-hop transmission, where the reward is determined by using the residual strength of nodes and the distinction in spatial depth between nodes in the praise function of the Q-mastering set of rules. The proposed Q-studying-based routing algorithm, however, is not designed for the clustering-primarily based
network topology. The authors in [7] implemented the shortest path routing to forward facts, which may additionally affect some nodes having better visitors load than others, thus main to strength hole issue. consequently, the life of the community.

IV. ENERGY CONSUMPTION MODEL

The energy model is used to calculate energy [14], which had proposed for underwater acoustic networks. According this model, $T_p$ denotes the transmitting time, $A(d)$ denotes energy attenuation and $d$ denotes the distance.

$$E_{tx} = P_t \times T_p \times A(d)$$

$$T_p = \frac{M_b}{S_v}$$

$M_b$ denotes the size of the information packet

$S_v$ is the transmission speed

$$A(d) = d^\lambda \times \beta^d$$

Where $\lambda$ is the spreading factor (1.5 for practical). The parameter $\beta = 10 \frac{\alpha(f)}{10}$ is determined by the absorption coefficient $\alpha(f)$, which can be calculated by using following formula:

$$\alpha(f) = 0.11 \times (10^{-3} f^2/1+f^2) + 44 (10^{-3} f^2/4100+f^2) + 2.75 \times 10^{-7} f^2 + 3 \times 10^{-6}$$

In this simulation, some assumptions are:

- Base station is remaining stationary all the time.
- All the sensor nodes spread over a three dimensional space.
- Both gateway nodes know the area of the base station.
- Each sensor node has same initial energy.
- All nodes measure the natural parameters and send it to the receiver node.
- Once every one of the nodes finish the data transmission to the base station, it is called as one round.

V. THE PROPOSED ALGORITHM

Mutihop Energy Efficient K-Means Clustering Algorithm (MH-EKMC)

In this algorithm, k-means clustering approach is used to form clusters. This algorithm has three phases: (1) cluster formation phase (2) Cluster head selection (3) Data transmission phase. In cluster formation phase, k-means clustering method is used to form the clusters. In the cluster head phase clusters area selected randomly according to distance. In data transmission phase, data is transmitting to base station. In this phase the concept of two gateway nodes is added to collect, receive and transmission of data. In this phase, firstly, calculate the distance from all cluster heads to base station, gateway node 1 and gateway node 2. Then the cluster heads checks the minimum distance. If the distance from cluster head to base station is minimum, CHs directly sends its data to base station. If the distance from cluster head to gateway node one and gateway node two is minimum than the cluster heads sends its data to gateway these gateway nodes and these gateway nodes are directly connected to base station to forward the data. Now evaluate performance on total energy consumption, first node dead, number of dead nodes and number of alive nodes. This algorithm shows better results than direct transmission.

Algorithm:

Step 1: Cluster formation
Apply k-means algorithm to form clusters

- Each cluster k(i) contains a number of nodes i=1 to n
- Initially all nodes have the same energy.

**Step 2: Cluster head selection**

- Select k initial cluster heads
- Nodes join in the nearest cluster

**Step 3: Data transmission**

- Calculate distance from cluster heads to BS, GT1 (Gateway 1), and GT2 (Gateway 2).
- If distance from CHS to BS is minimum than send data to BS, otherwise send it to GT1, GT2.

**IE (Improved Energy)**

All nodes are randomly distributed to collect data about environmental parameters. The physical location of each node is fixed; therefore, the distance of any node and BS can be calculated. The packet size of collected data from each node is equal. Each node may act as a sensing node or a cluster head but not both in each round. All sensing nodes are responsible for only collecting data and forwarding them to their corresponding cluster header (CHs) are responsible for receiving data from sensing nodes, aggregating them and forwarding to BS. BS is responsible for performing all calculations in each round, and it is power-equipped enough for this task.

\[
E_{SN}^{i} = E_{i} - (e_{i}^{R} + e_{i}^{G})
\]

\[
E_{CH}^{CH} = E_{i} - (e_{i}^{R} + e_{i}^{G} + e_{i}^{C})
\]

where, \( E_{SN}^{i} \) is the residual energy of sensor node and \( E_{CH}^{CH} \) is the residual energy of cluster header node.

**LEACH**

Grouping conventions assume a critical part in dragging out the lifetime of WSNs. The LEACH convention is acquainted by [8] with lessen worldwide interchanges among WSN by gathering the hubs into various little estimated groups. The arbitrary choice of CHs addresses one of the principal flimsy parts of LEACH, the difficulty that this work attempts to address. Thusly, numerous methodologies have been acquainted with deal with this issue. Like this work, the accompanying endeavors are acquainted with improve the arrangement period of LEACH convention utilizing various methodologies to upgrade LEACH during the fundamental undertaking of the arrangement stage (to select CHs).

Low Energy Adaptive Clustering Hierarchy (LEACH) by Heinzelman [9] [10] is the most well-known grouping convention which had been a reason for some further clustering conventions. The main objective of LEACH is to have Cluster Heads to lessen the energy cost of sending information from typical hubs to an inaccessible Base Station [3]. In LEACH, hubs arrange themselves into nearby clusters with one hub going about as group head. All non-group head hubs (typical hubs) communicate their information to the cluster heads. Cluster head hubs do some information totally and additionally information combination work on which ought to be communicated to Base Station. The cluster heads change haphazardly throughout some stretch of time to adjust the hub's energy dissemination.
VI. SIMULATION AND DISCUSSION

Table 1: Simulation parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Energy</td>
<td>10J</td>
</tr>
<tr>
<td>Network Size</td>
<td>100×100×100 m³</td>
</tr>
<tr>
<td>Number of Nodes</td>
<td>100</td>
</tr>
<tr>
<td>Number of Gateway</td>
<td>2</td>
</tr>
<tr>
<td>Etx</td>
<td>0.0271J</td>
</tr>
<tr>
<td>Erx</td>
<td>0.0090J</td>
</tr>
<tr>
<td>Communication Model</td>
<td>coastic</td>
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</tbody>
</table>

In MH-IE-LEACH algorithm 45 nodes has died in round 200 and in MH-EKMC algorithm 52 nodes has dead in 200 rounds and direct transmission 95 nodes has dead in 200 rounds. Therefore, in this set of simulations, the MH-IE-LEACH algorithm is 60% more efficient as compared to the direct transmission and MH-EKMC.
shows the deployment of nodes in three-dimensional space. In this figure, 100 nodes have been deployed with an area (100x100x100). The base station is placed with coordinates (50x50x150).

The first node dies using indirect transmission algorithm after 33 rounds. In MH-EKMC, the first node dies after 53 rounds, and finally, MH-IE-LEACH first node died in 63. In this simulation, the MH-IE-LEACH is more efficient in terms of network lifetime as compared to direct transmission.

VII. CONCLUSION

A large portion of the proposed algorithms were just connected to two-dimensional systems where all sensor nodes are dispersed in a two-dimensional plane (2D). In this research, a few two-dimensional (2D) geometric topologies are extended to three-dimensional plane (3D). The main objective of this paper is to design a routing protocol for underwater sensor network that will increase the energy efficiency of the overall network. In this work, multi-hop technique in MH-IE-LEACH algorithm is applied for underwater wireless sensor network by considering some parameters like first node dead, last node dead, dead nodes per round and energy consumption per round by which the lifetime of the overall network is improved.

REFERENCES


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