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An Optimal Secure Communication Using Multipath Data Transmission to Minimize Energy Consumption in Underwater Wireless Sensor Networks

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Abstract: Underwater Wireless Sensor Networks (UWSN) differ from terrestrial wireless sensor networks in the battery life. While several protocols and models have been developed for terrestrial networks, they are rarely used in underwater sensor networks. A lot of work is now being put into designing effective protocols considering underwater communication features. Complexity of the undersea environment and the slow transmission speed, an important difficulty in this field is attacks with high delay tolerance, utilising an inadequate architecture for multipath variable data transmission and encryption.

To overcome the issues, UWSN with cluster-based data collection task is experienced and clarified for efficient data transfer, reduced data redundancy and improved system lifetime. Data collection procedures help address the energy consumption of sensor nodes. To localization-based data communication, localization-free data communication, and cluster-based data communication. Various deployment architecture models use data communication processes based on these routing protocol architectures. Higher data speed and lower power consumption result in better performance and PDR (Packet Delivery Rate). The design of a Multi Routing for Improving Security using three phases a Genetic algorithm Genetic algorithm with Time-Based Trustworthy Links (TBTL) and Recursive Spectral Neural network (RSN^2) using Spectral Social Spider Optimization (SSSO) and Time-Based Trustworthy Links (TBTL) for utilizing the dynamic, static routing and Encryption for improving the Security and reduced energy level. In addition, the Final proposed Recursive Spectral Neural Network (RSN^2) Selects relays depending on the depth of the environment, minimises hops on the link discovered at depth thresholds, and addresses the data transmission loop problem. These methods are compared with the optimised distributed Optimal Distributed Energy Efficient Hybrid Optical - Acoustic Cluster Based Routing Protocol (EEHCRP) is Underwater wireless sensor networks are intended to use less energy. UWSN sensors are planted at varied depths, and the amount of data provided varies as well. Some nodes engage in data transmission to the greatest extent possible, causing them to expend energy and die prematurely. This shortens the network's lifespan. Increasing network lifetime is a scientific topic that must be addressed. Effective node power management will extend the life of the network. Simulation results show that the Recursive Spectral Neural Network (RSN^2) performs better in network lifetime, transmission loss, and data throughput than other popular energy-balanced routing algorithms.

***Keywords**: Underwater wireless sensor networks (UWSN), data transfer, static, dynamic, Packet Delivery Rate, Nodes, routing protocol, network lifetime.*

1. Introduction

UWSNs have been gaining increasing attention as viable for aquatic based studies. Detector bumps are clever aquatic physical things. It detects and records current and literal data about aquatic terrain. In fact, as compared to land, understanding of water geography is low. Because the ocean is becoming increasingly important in human life, uncovering the enormous unusual ocean volume has been increasingly important in recent decades. Detector bumps are smart aquatic physical items that can sense/record information in aquatic landscapes.

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Wireless communication methods Interactions between underwater acoustic (UA) and radio frequency (RF) communication. A vast checking zone can be covered by several self-coordinating sensor nodes positioned on the ocean floor. The sensor network framework might help a marine ranching organisation screen sea components like temperature, salinity, profundity, profile temperature salinity, and split oxygen, chlorophyll, turbidity, and pH. The ability to detect an early warning level of ecological concerns, such as centipedes, red and green tides, ocean ice, oil slicks, and so on, by assessing data

Methods of wireless communication Underwater acoustic (UA) and radio frequency (RF) communication interactions. Several self-coordinating sensor nodes placed on the ocean floor can cover a large checking zone. The sensor network framework could assist a marine ranching company in screening sea components such as temperature, salinity, depth, profile temperature salinity, and split oxygen, chlorophyll, turbidity, and pH.

The ability to detect ecological concerns such as centipedes, red and green tides, ocean ice, oil slicks, and so on at an early warning level by analysing data.

Multipath routing, as opposed to single-path routing, enables source nodes to identify numerous routes to destination nodes to enhance network performance. Additionally, Multipath Routing Protocol (MRP), which adds redundancy to original packets, can withstand a specific amount of data packet losses. To increase the dependability against the strict communication conditions, multipath routing was in use. On the distribution of elimination networks, the heterogeneity of various pathways, however, was not taken into consideration.

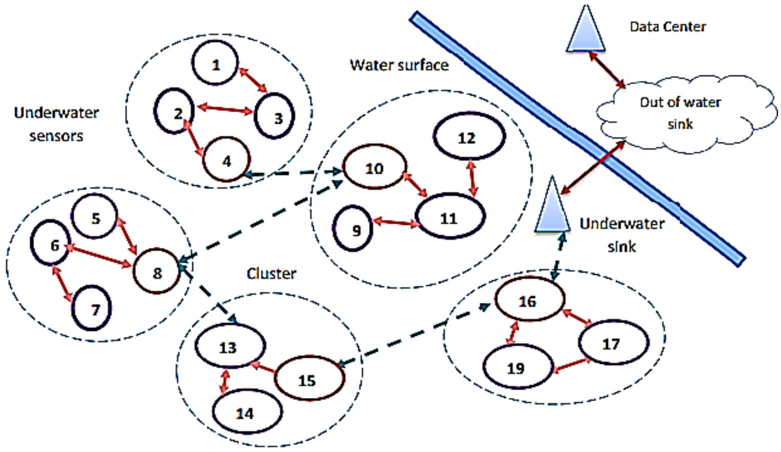

Figure 1: Basic flow diagram for an underwater sensor network in a cluster

Using the design in Figure 1, the entire correspondence within and between clusters is meaningful. Engineering disrupts nodes across locations to identify potentially detrimental changes. Data collected by single or multiple hops are sent to the cluster head. CH collects and aggregates information from all individuals in the cluster. At that time, the cluster head then sends a debriefing message to the coastal/commercial sinks and the upstream corresponding UW sinks. This is known as intra-group communication. If the CH is far away from the UW-Sink, the digest message cannot be directly sent to the UW-Sink. Correspondence between clusters takes place. A cluster head transmits the aggregated information to neighbouring clusters. These clusters send data to the stack until the collected messages reach the UW-Sink.

EEHRCP's goal is to make energy-effective directing conventions. The energy levels of the path are kept consistent, and the hub with the most remaining energy is utilized for transmission, adjusting the hub load and expanding network lifetime.

Optimizing transmission power efficiency is critical to improving data performance and network lifetime. The Time-Based Trustworthy Link (TBTL) UWSN protocol adapts its routing and data transfer techniques to the actual needs of UWSNs. For global optimization, it isn't easy to achieve energy equilibrium with existing algorithms. Simulation results show that the genetic algorithm (GA) outperforms other popular energy-balanced routing algorithms regarding network lifetime, transmission loss, and data throughput.

A method using the Multipath Routing Protocol (MRP) to lower the rate of packet loss in the UWSN under consideration. For underwater acoustic pathways, Based on the RSN2 algorithm, a multipath routing approach based on SSSO with altered link weights. Furthermore, the IDES encryption method, which generates safe keys and considers the possibility of transmitting multiple channels, increases the chances of successful communication. The simulation results show that the proposed routing protocol can raise or maintain network energy levels and longevity while lowering the UWSN's packet loss rate.

The suggested network communication protocols are directly applicable to UWSNs due to the particular constraints of underwater environments. Many protocols, such as media access control, network protocols, and transport protocols, have been developed for UWSNs because to the specific characteristics of underwater networks. UWSN routing protocols are classified as localization-based or localization-free. Furthermore, some do not describe the benefits and drawbacks of the routing technology or protocol under consideration. These aspects must be presented so that the reader may grasp the procedure.

2. Related work

Umer Farooq et al (2021) described as, UWSN have snatched the interest of scientists and have been utilized in a scope of organizations. Natural observing, submerged oil and gas investigation, military reconnaissance, shrewd farming, and broadcast communications are only a couple of the purposes for UWSN. Notwithstanding, serious hardships like as restricted network lifetime, low hub figuring ability, and high energy utilization while activity make UWSN vulnerable.

Guanglin Xing et al (2021) defined as. The majority of the clustering strategies in use today centre on centralised cooperation-based cluster header (CH) selection. Acoustic sensor nodes are made to preserve energy due to their low energy efficiency, which makes it impossible to achieve such integration.

Kamal Kumar Gola et al (2020) defined as, Sensor nodes observe their surroundings in a UWSN, and the data are conveyed to sink nodes before being sent to base stations for processing. Water covers 70% of the Ground's surface, as is generally known.

Shahzad Ashraf et al (2020) defined as, underwater data collection for pollution detection, environmental management, marine mining, catastrophe avoidance, and strategic monitoring necessitates robust and precise communication linkages between sensor nodes. It is vital to select the best link between the source and destination nodes.

Xiaoying Song et al (2020) defined as, when multi-hop data transmission happens between the cluster head (CH) and the sink, the cluster head near the sink becomes significantly loaded, and the node's energy consumption increases, resulting in energy leakage. Clustering Techniques for Sensor Networks

Nighat Usman et al (2020) defined as, numerous acoustic sensors are utilized with limited assets like memory, batteries, figuring power, and correspondence reach to gather the fundamental data from the submerged climate. As a result of the unfriendly climate, moving a hub's assets submerged is incomprehensible.

Shaobin Cai et al (2019) defined as, Customary multi-jump information assortment techniques in UWSN have a few restrictions, including high power utilization and extreme power utilization lopsidedness. As of late, portable edge parts (e.g., Independent Submerged Vehicles, AUVs) have been broadly utilized in submerged information gathering to resolve the issue of energy utilization irregularity.

Amir Chaaf et al (2021) defined as, Poor location node distribution, an imbalance in overall energy consumption among different sensor nodes, dynamic network topologies, and a poor selection of relay nodes can all result in void holes.

Ghufran Ahmed et al (2021) defined as, Due to unfavourable underwater circumstances, UASN encounters a number of challenges and issues, including poor bandwidth, node mobility, propagation latency, 3D deployment, power limits, and expensive manufacturing and deployment costs. In underwater wireless sensor networks (UWSN), the major issue with energy management is thought to be low battery power of nodes.

Arshad Sher et al (2018) defined as, Acoustic nodes have limited battery power and it is desirable to use it efficiently. Hence, the network is prone to sudden failures as the battery cannot be replaced. Therefore, efficient consumption of node batteries is essential to extend network lifetime and optimize available resources.

Tejaswini R Murgod et al (2020) defined as, Long spread times, high piece blunder rates, data transmission limits, uncontrolled hub versatility, water flows, and asset shortage are difficulties for UWSNs. Subsequently, clearly great steering conventions should be created and executed.

Ashwini B Gavali et al (2021) defined as, An technique to data transport from underwater sensor nodes to surface sinks that is both energy and QoS efficient. Protocol energy optimisation via routing optimisation (EORO) is proposed to overcome these difficulties.

Neelakandan Subramani et al (2022) defined as, UWSNs have piqued the scientific community's interest for a range of applications, including disaster management, water quality prediction, environmental monitoring, and underwater navigation. A UWSN is made up of numerous sensors placed over rivers and oceans. Its mission is to study the aquatic environment. However, energy economy is a big challenge because underwater sensors have limited power and batteries are difficult to charge or replace.

P. Agheli et al (2021) defined as, Autonomous Underwater Vehicles (AUVs) and Unmanned Aerial Vehicles (UAVs) are relayed via a triple-hop UWSN to provide end-to-end communication between SNs and Access Points (APs). Underwater Optical Communications (UWOC).

C. Correa et al (2022) defined as, Lack of temporal and spatial information on groundwater availability and quality hinders good decision making.

Ghoreyshi, S et al (2019) defined as, a CMDG (cluster-based mobile data collection) technology for enormous scope UWSNs that offsets information gathering delay with energy reserve funds. To group acoustic sensors and cover their heads in unbelievably short cycles, we initially characterize the undertaking as an improvement issue and afterward utilize two productive calculations to get the close ideal arrangement in the littlest timeframe. Varieties influence CMDG execution. Apparently, CMDG is the principal AUV trip arranging framework fit for dealing with UWSN sensor versatility.

Wadud, Z et al (2019) defined as, the development of efficient routing algorithms is extremely desirable and has long been the focus of research. To address these issues and improve the performance of current protocols, various routing protocols have been developed.

Ismail, M. et al (2020) defined as, UWSNs must overcome significant challenges such as hostile environments, substantial propagation delays, and sensor node device battery power constraints. A variety of solutions have been offered to tackle these challenges.

R. Sundarasekar et al (2023) defined as, Major research issues in underwater acoustic sensor networks (UWASN) include reliable data transmission and power control. High packet loss, limited bandwidth due to high power generation, network lifetime due to high propagation latency, and low precision are some of the reasons. If the data is kept for an extended period of time. Because of the necessity for QoS applications and the limited number of sensor nodes, UWASN prioritises energy conservation and quality of service (QoS).

J. Qadir et al (2020) defined as, aquatic environment, underwater wireless sensor networks (UWSN) are challenging protocols in terms of energy economy and dependable communication. Due to limited power, sensor nodes installed in a certain area cannot communicate with each other for an extended period of time. Furthermore, the sluggish speed and narrow bandwidth of sound waves cause significant delays and large transmission losses, compromising network reliability. There are numerous protocols available in the literature to solve such difficulties.

Author/Year	**Title**	**Proposed Technique**	**Drawbacks**
Abílio C et al/2021	The IoT: A Remote Source Water Observing and Control Framework	Message Queuing Telemetry Transport Protocol (MQTT)	Cannot manage resources IoWT
H. Luo et al/2022	Advances in Cross-Air/Water Limit Correspondence for Submerged Sensor Organizations: A Survey	air/water cross-boundary communications	The complexity of the channels of the various transfer media presents significant challenges in seamlessly crossing the interface between air and water.
T. H. Assumpção et al/2019	Citizen campaigns for environmental water monitoring: lessons from field trials.	Adaptive data collection	Resident lobbies for ecological water checking: illustrations from field tests
Ahmad A et al/2020	Opportunistic cooperative transmission for underwater communications based on key physical variables of water	opportunistic cooperative transmission scheme	complicates the communication process inside the water
W. Wei et al (2020)	LED-based wireless underwater optical communication for small mobile platforms: experimental hydrographic studies in turbid lakes	LED-based UWOC systems	Low bandwidth
Y. Gou et al(2023)	A MARL-Based Far reaching Power The executives Technique for Advancing Fair Reuse of	FRI for UWSNs	Low bandwidth/network lifetime

	UWSNs		
L. Zheng et al(2023)	An original sensor planning calculation in light of profound support learning for bearing-just objective following in UWSN	Sensor Planning Calculation In view of Profound Support Learning	Lack flexibility,
H. Wang, et al(2022)	A probabilistic push-based procedure for safeguarding sound source area security in submerged acoustic sensor organizations	Push-based probabilistic method for source location privacy protection (PP-SLPP)	UASN creates challenges with security and privacy
P. Kamboj et al(2023)	Multipath Routing with QoS Awareness in Software-Defined Networks	QoS-aware dynamic multipath routing scheme	low bandwidth and high latency
Mittal, S. et al(2021)	Different Correspondence Advancements and Difficulties for Executing UWSN.	underwater sensor technology	Signals used for communication and various functions

Nayyar, A. et al characterized as, Because of confined transmission capacity, high energy utilization, high idleness, parcel postpone difficulties, and security concerns, submerged sensor organizations (UWSNs) are vital in playing out a wide range of submerged undertakings. The execution of earthly sensor network steering conventions in UWSN is generally hard because of engendering delay, bundle postponement, and energy productivity.

Islam, T et al (2019) characterized as, a plan that incorporates a far reaching assortment of boundaries that characterize the critical components of a steering convention. Besides, an outline of the techniques utilized in each venture is given so peruse can appreciate the task's fundamental activity. Share your contemplations on the framework's advantages and downsides.

Khan, H et al (2020) characterized as, the impact of the submerged climate, the unique idea of acoustic, radio, and optical frequencies, and the super submerged clamour conditions all add to the trouble of planning steering conventions. This paper presents an outline of various difficulties experienced while making directing conventions, as well as a rundown of the commonplace steering conventions utilized in UWSNs, as well as their advantages and disadvantages.

Awan, K.M et al (2019) characterized as, a UWSN is made out of a huge number,These organizations are utilized to interface various ground path and stations. Low transfer speed, long spread delays, 3D geography, media access control, directing, asset usage, and power limitations are presently an issue for UWSNs.

Shovon, I. et al (2022) characterized as, it is crucial to fundamentally look at laid out conventions. This report gives a total overview of UWSN multipath directing conventions and orders them into three significant gatherings.

Mhemed, R et al (2022) characterized as, the elements of the UWSN climate and organization plan, the presence of void area can catch information bundles at the sensor hub and keep them from continuing to the sink. UWSN directing worldview. In an OR-based directing framework, the most proper sensor hub is picked as the following bounce sending hub in light of the convention rules for at first sending the information parcel.

J. Zhang et al (2022) characterized as, powerful strategies for creating web based steering calculations. Momentum research, be that as it may, keeps on depending on wasteful internet based single-pass steering (OSR) techniques. In this paper, we assemble an Internet based Multipath Steering (OMR) calculation in light of the MWU plan to follow benefit of organization way assortment.

M. Besta et al (2021) defined as, A UWSN is made out of a huge number, for example, vehicles and sensors that are conveyed in specific sound zones to perform cooperative observing and information assortment exercises. These organizations are utilized to associate various ground hubs and stations. Low transmission capacity, long proliferation delays, 3D geography, media access control, steering, asset use, and power limitations are right now an issue for UWSNs.

Z. Wang et al (2022) defined as, To avoid node overload, these nodes are given a topology-corrected contention radius, which enables them to pool their remaining energy and vote for nodes to participate in the cluster head election process. A running node determines the ultimate cluster head based on two-dimensional matching features. Finally, the drawbacks of traditional multihop communication are solved by proposing an energy balance lifetime maximum routing problem for various multihops based on sequential quadratic programming (SQP). The greatest answer for this challenge is Particle Swarm Optimisation (PSO), which provides effective multi-hop transmission planning for WSNs.

N. Maksić et al (2021) defined as, The first routing solution takes data centre flows into account. The proposed method operates in the data plane of the packet processing pipeline of programmable packet forwarding devices to obtain the required performance. When a new flow comes, it transmits routing updates to upstream switches, directing them to the best possible route. The introduction of new streams causes routing changes. It enables the proposed algorithm to deal with sudden variations in traffic volume, i.e. the widespread flow-in-cost communication pattern, which has historically been a source of worry for data centre routing algorithms.

3. Implementation of proposed method

The underwater SN consists of sensing, communication, power and processing units with sound modems. Sensor devices measure physical conditions like temperature and pressure. The data is processed by the processing unit into the desired signal format. All of the above-mentioned units require electricity, and the power unit is in charge of supplying them with the power they require to execute their responsibilities in the underwater environment.

This research study analyzes a number of publications related to energy consumption and expertise in using efficient data collection techniques. A cluster-based data transfer protocol can be very effective for collecting large amounts of data and saving energy.

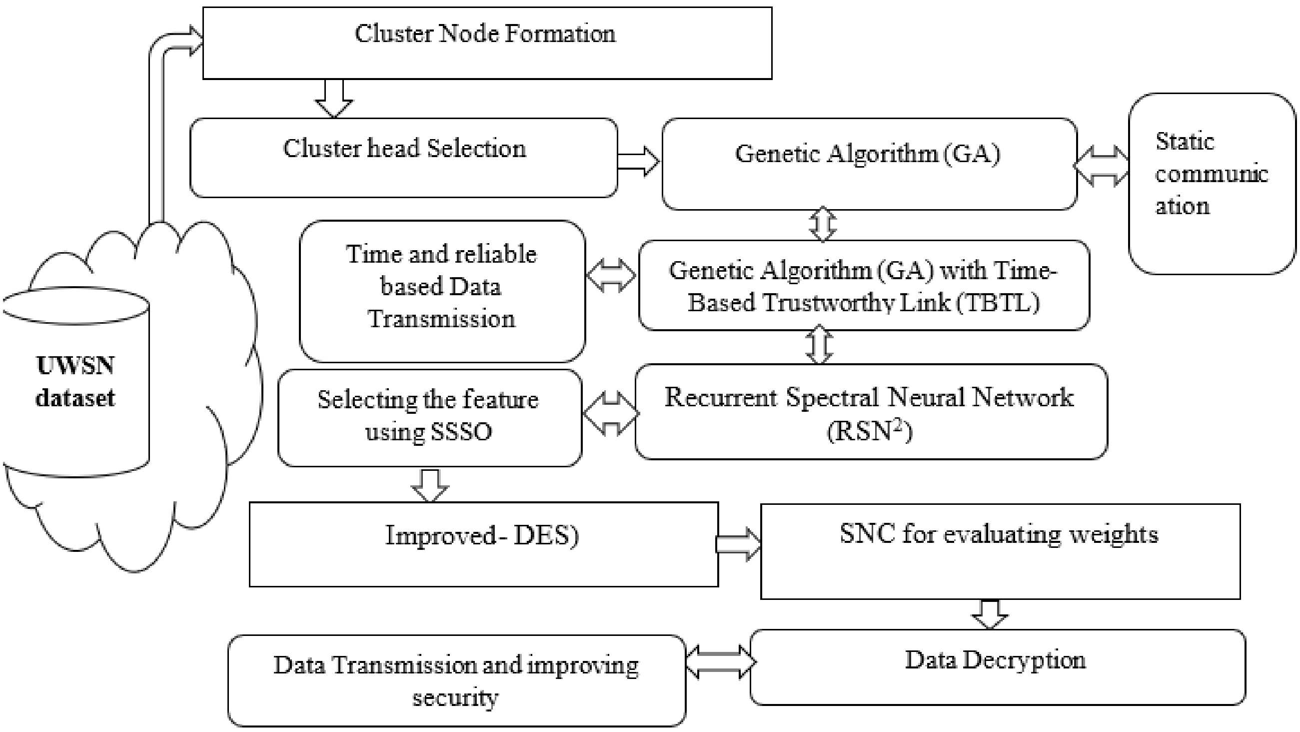

Figure 2: Proposed block Diagram

Figure 2 is a proposed diagram based on underwater sensor networks and improving security. Initialize a UWSN with a cluster and design node selection; First method is Genetic Algorithm (GA), is statically transmits the node in clusters. The second method, Genetic Algorithm (GA) with Time-Based Trustworthy Link (TBTL), dynamically selects nodes based on time-based reliable connections. TBTL utilizes a genetic algorithm (GA) and reliable routes. Recurrent Spectral Neural Network (RSN^2) is the final method for improving security and transmitting data using encryption. It transfers the node or features using SSSO to select maximum weights features. Furthermore, only a few nodes are involved in the end-to-end routing process, with no requirement for sensor node location information.

3.1 Underwater wireless Sensor network

UWSN are emerging as a viable technology for solving marine life riddles and other underwater applications. With this in mind, we investigate the most recent and promising approaches for underwater nodes to communicate inside a network. More information regarding underwater channels is available, with an emphasis on both acoustic and optical communications. Channel modulation and coding techniques are also covered. This is followed by a brief review of node location techniques and the routing protocols that can be employed for the sorts of communication necessary.

3.2 Routing Techniques

A UWSN is made up of a large number of sensor nodes located at various depths within the area of interest. Because nodes at sea or beneath the water cannot connect directly with surface buoys, multi-hop communication via a routing mechanism is required. An effective routing method should provide the shortest path between sources and sinks. The design of a routing protocol is determined by the network's application requirements as well as the level of precision and optimisation necessary, which is determined by the availability of resources.

Energy Based Routing (E-PULRP) is an Energy Optimised Path Unknown Layered Routing Protocol (E-PULRP) in which the entire network is separated into layers and each node in a layer can connect with the sink in the same number of routes. Relay nodes in multi-hop communication are chosen based on their distance from the sink node. In other words, the node closest to the sink and farthest away from the source is the next hop. Allowing inactive nodes to sleep lengthens the network's lifespan. However, because this protocol does not account for node mobility, it is inappropriate for real-time underwater applications.

3.3 Cluster Node Formation

Using the REQ/REPLY protocol, nodes communicate their identities and node values to their neighbours. When participating nodes identify neighbours, they exchange information on how many 1-hop neighbours they have. A one-hop neighbourhood is used to choose nodes from the trusted contact table. Other nodes may be cluster members or local nodes. Update the node's trust value accordingly. Short lengths are chosen around the long-distance path to produce standard range groups. The radius of the new circle rises with the distance between the two clusters, while the centre is computed by averaging the points in the cluster.

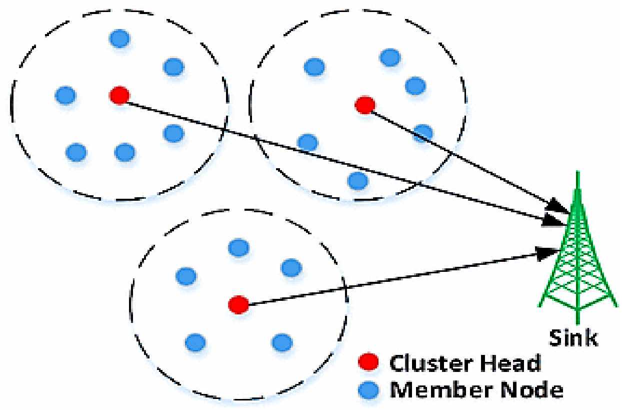

Figure 3: Cluster Node Formation

Figure 3 described as, Network nodes are organised into clusters, each with its own cluster head (CH). Each cluster's data is collected and delivered to the BS. Throughout the network's lifetime, clustering serves to mitigate and enable redundancy.

3.3.1 Cluster head selection

Cluster Head (CH) selection selects a node as the cluster's leader point. The cluster head stores information about the cluster. This data comprises a list of cluster nodes and paths to all. As a result, to provide secure routing, you can choose a secure cluster head for each cluster. A security solution called Trust Algorithm is proposed to improve the selected cluster head. In addition, we examine the drawbacks of the sub-cluster selection procedure and propose a novel prior as an alternative to the close cluster selection process.

3.4 Genetic Algorithm (GA) for Static routing

A WSN Substitution Movement Technique Based on Genetic Algorithms (GA). The network region is partitioned into an ideal number of clusters, each with sink paths. The GA procedure selects the best sink position at the cluster's root. A rolling sink stops at an ideal sink location and receives data from the associated cluster node. When sending data, improved sink conditions lower node power usage. GA initialises the number of chromosomes to find the best sink site for the cluster.

Reduce the energy consumption of fixed cluster child nodes for data transmission and modify the energy consumption of network nodes. Data transport solutions based on clustering are both energy efficient and dependable.

BEGIN:

N= 0; //Evolutionary population generation

Init P (N); //Population initialization

Fitness P (N); //Fitness function While (n =Genetic Gene rations) N++;

Process P(N); // Cross and mutation

Fitness P(N); // If the termination condition is not met, th e search is continued

END.

3.4.1 GAR Route Searching

To start the directing system, a source hub S communicates a directing solicitation (RREQ) as a neighborhood broadcast parcel. It is gotten by all path inside hub S's communicate inclusion. For hub S, each RREQ demonstrates a source and an objective hub. Search for a course. Each RREQ distinguishes the directing inquiry's source and objective path. At the point when another hub gets this RREQ, the neighbors start trading data in regards to connect soundness, connect transfer speed, and the hub's ongoing power. All the while, in the event that this hub is the objective hub for this course query, it will send a re-course answer (RREP) to the course query's starting point hub.

- Create the chromosome using the network node ID;
- Enter the cutting edge in light of the significance of individual variation;
- Portrayal Hybrid activity in light of the predefined hybrid likelihood;
- Execute the change method as per the transformation esteem determined;
- Assuming the calculation's end condition is met, continue to stage 6, in any case, and continue to stage 2.
- Produce the ideal chromosome.

3.4.2 Route Maintenance

Continuous acknowledgments are used by GAR to detect whether a connection is ready for data delivery. Subsequent to getting an affirmation from a neighbor, a hub tries not to recognize this neighbor for a concise timeframe until the organization interface associated with this neighbor generally gets an affirmation because of a reaction. Assuming the quantity of retransmissions of an affirmation demand moves toward the most extreme permitted and no response is gotten, the source hub thinks about that the connection to the following jump target hub is presently broken and erases utilizing this wrecked connection. From routing memory, each node communicates a route error (RERR).

3.5 Genetic Algorithm (GA) with Time-Based Trustworthy Link (TBTL)

A genetic algorithm is a search tool that is based on natural selection and genetics dynamics. To develop optimal solutions, genetic algorithms execute a search process amongst several alternative optimal locations based on a probability function. This suggests that the operator probabilities should be changed as the GA evolves. The suggested method places and deploys UWSN nodes using Genetic Algorithm (GA)-based optimisation techniques to maximise coverage, minimise the number of necessary nodes, and assure effective communication. Techniques based on genetic algorithms to improve the energy efficiency of information transit from source nodes to destination nodes.

An evolutionary approach can be used to solve multipath routing challenges in wireless sensor networks. In addition, when looking for a path, each network node's energy consumption and fault tolerance should be considered to find the best way. This can be accomplished using the genetic algorithm crossover and mutation operations.

To build a trust connection between nodes, the nodes' behaviour must be translated into a value representing the level of trust.

$$DT_{ij}^{t} = \gamma * HT_{ij}^{t} + (1-\gamma) * (R_j + S_j)^{t}$$

$$HT_{ij}^{t} = \lambda(DT_{ij}^{t-1} + HT_{ij}^{t-1})$$

Where is the impact of previous trust value on current direct trust value determined? The bigger the value of, the more influential prior trust value is on direct trust value.

$$R_j = \frac{\theta * receive\_message_j - rejection_j}{message_j}$$

$$S_j = \frac{\theta * send\_message_j - un\_send_j}{message_j}$$

Where (Rj+Sj)t denotes the current confidence value, and and (1-) signify the weight of the confidence value following the change of the prior confidence value and the current confidence value, respectively. 01, and the value varies depending on the WSN. Get_messagej maintains track of how many data packets node i receives and sends a message when they arrive. The number of data packets transferred by node j is tracked by j. Message j represents the total number of data packets delivered and received by the monitoring node j. The numbers reject j and un_send j show the number of data packets rejected by node j when receiving or sending.

3.5.2 Multipath Routing in Dynamic Selection

The cluster-based UWSN programme has been coded to reduce the amount of cluster head (CH) transactions in the network, and the protocol queue management scheme has been updated to increase coding opportunities. Dynamic routing is the process of determining the best path for a data packet to take through a network in order to reach a given destination. Dynamic routing is a system that allows network components to exchange routing information in order to identify the optimum path. Routing protocols are used to find and improve network paths.

Step 1: Establish the initial node count

Step 2: Decide the node ids of the source and objective.

Step 3: Then_i's critical sensing point. If the nearest neighbour node indicates n_n and the source node indicates s_(n),

$n_i < m_i$

Step 4: Determine the distance between an unknown node and each of its neighbours.

Step 5: Determine the average distance between each neighbour node

Distance $d_i = \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2}$

Where the coordinates of two neighboring nodes, sequences 1 and 2, are $x_1,\ x_2, y_1,\ y_2$.

Step 6: Each neighbor node registers the normal of every obscure node and acquires data for every obscure bounce distance that arrives at the principal node.

$a_i = \frac{\sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2}}{h_i}$

Where h_i the increases from a neighbouring node.

Step 7: Verifying the communication node id

$if\ hop > h_i$

Update the packet detecting system.

If not, throw away the detection packet. Repeating the previous stages up until all node-to-node communication has been covered.

The routing table's communication path between the two nodes is intended to keep them separately. The distance covered by each hop is the estimated distance.

3.6 Recurrent Spectral Neural Network (RSN^2)

A Recurrent Spectral Neural Network (RSN^2) is a sort of artificial neural network in which node connections form a directed graph. This allows us to see the temporal dynamics of a time series.

The primary stage comprises of forward information engendering, though the second comprises of in reverse blunder spread. Let S and O address the result vectors of the covered up and yield layers, individually, and X address the information vector of the info layer. The weight boundary framework from the info layer to the secret layer and from the secret layer to the result layer is signified by V. Additionally, U means the boundary grid of the inactive layer circle structure.

$$net_j(t) = \sum_{i=1}^{n} x_i(t) v_{ij} + \sum_{l=1}^{m} h_l(t-1) u_{jl}$$

$$h_j(t) = f(net_j(t))$$

Where $v_{n,}$ i-th input layer neuron's connection weight to the j-th hidden layer neuron, and u_{jl} is The link value between the jth neuron in the current layer and the first l neurons in the hidden layer.

3.6.1 Softmax classifier

Every neuron in a layer that is fully linked is also fully connected to every neuron in the layer above it. The output value of the final fully connected layer is given to the output layer, which is identified by the Softmax and each neuron in the completely connected layer typically chooses the ReLu function as its activation function.

The activation function of trains S (f) $=\begin{cases} b = 1\ if\ \sum_{i-1}^{n} w_i b_i \geq y \\ b = 0\ otherwise \end{cases}$ where S(f) the interclass logistic transformation-trained neuron's logistic activation is $w\_((t+1)) = w_t - \mathbb{N} \triangle w_t$ and $b_{(t+1)} = y_t - \mathbb{N} \triangle b_{t.}$

The input variables assist segment the areas and learn the features connected to the hidden neurons. The input features are learned on a classifier structure and labelled with neural weights reflecting the class.

3.6.2 I-DES

The main purpose of underwater sensor network nodes is energy efficiency, therefore the encryption process cannot perform extremely sophisticated activities. Underwater nodes are often sparsely dispersed, and the plain text data is primarily information about underwater environmental attributes. The majority of data is delivered from sensor nodes to base stations. Control messages are sent from the base station to the sensor nodes seldom and infrequently. The length of the post-encryption is much longer, increasing node energy usage.

3.6 EEHCRP

The proposed framework incorporates different group CHs path. The CH is sent from a hand-off hub, which gathers information and conveys it to a sink hub: in the event that it is in transmission range, it is communicated inside transmission range; in the event that it isn't, it is sent inside transmission range. CH is the following nearest in range. At first, there were no CHs on the organization. The CH is chosen as the hub with the most excess energy and gets information from neighbors through these transfer path. Assuming that the sink or anchor hub is out of transmission range, the information is gathered and shipped off the following CH. Information is moved continually from the anchor hub to the sink hub utilizing between CH transmission.

3.6.1 Transmission of data

The cluster nodes are sleeping, but the CH is always active. A cluster member wakes up at the set time, listens to the channel for a while, and sends the observed data to the CH when it detects that the channel is idle. Cluster nodes generate data packets to send to the CH and then enter sleep mode.

```
For Cl Cluster € {1,2,......, S} Sectors
For an N node € {1,2,......., C} cluster
        A node starts at time t1.
         Data packet construction
Listen to the channel
   If your channel is free
        Transfer sensing data to CH.
        Wait for ACK
If I do not
        Go to line 5
End if
End for
```

The CH responds to the cluster members after receiving the data packet. This cycle is repeated until the CH gets a data packet from a cluster member. The CH then aggregates all of the node data and transmits it one level at a time till it reaches the sink node.

3.6.2 EEHCRP

The CH node waits for acknowledgement and data packets from the cluster members after delivering the notification packet. If a CH node is unable to connect to a cluster member node for an extended period of time, it checks the CT entry to establish a neighbouring attempt to contact, assuming that the cluster member node has departed the cluster territory. If the CH is unable to communicate with any node in the CT, it will switch from optical to acoustic mode before making an announcement. Cluster nodes provide little amounts of detected data to CH.

4. Result and discussion

The Anaconda tool simulates a proposition depending on simulation settings. Through this simulation, the effectiveness of the suggested protocols, including Genetic Algorithm (GA) Packet Overhead Protocol, Qos-Source Location Privacy Protection, and Low Energy Priority Electoral Multihop (LEMH), is examined and contrasted. Metrics compare packet delivery rate, latency, and throughput performance to bandwidth, network security, and transfer rates.

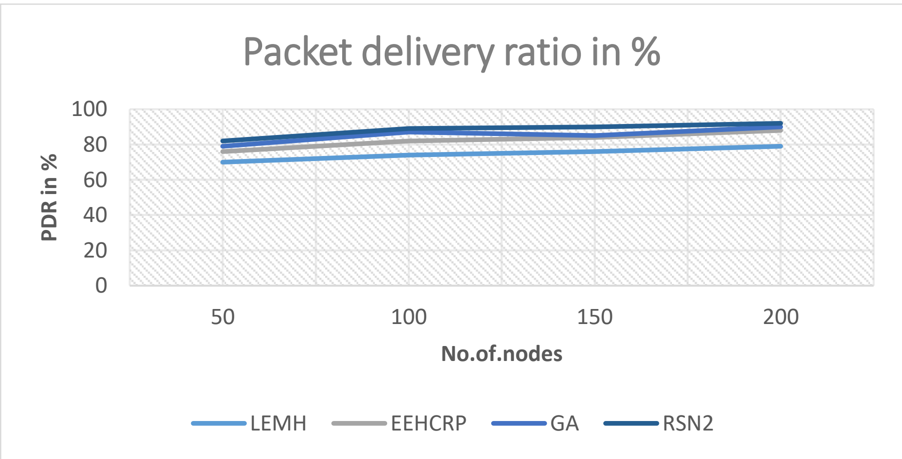

Figure 4. Comparison of PDR

Figure 4 when compared with the Genetic Algorithm (GA) approach and EEHCRP, LEMH displays packet delivery rates of 79% and 88%, respectively. Recurrent Spectral Neural Networks (RSN2) outperforms earlier techniques with a delivery rate of 92%.

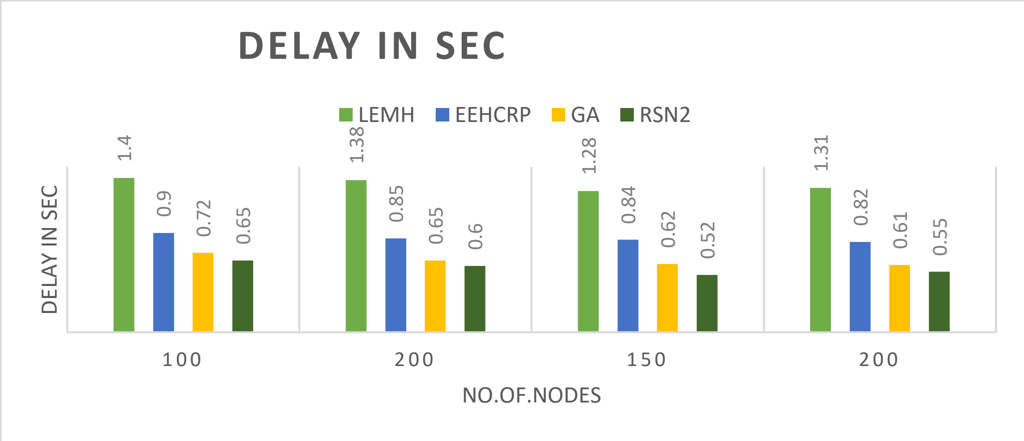

Figure 5. Delay performance

Figure 5 shows Recurrent Spectral Neural Networks (RSN2) outperform other algorithms in terms of latency, with a delay of 0.55 seconds over LEMH, 0.82 seconds over EEHCRP and 0.61 seconds over Genetic Algorithm (GA).

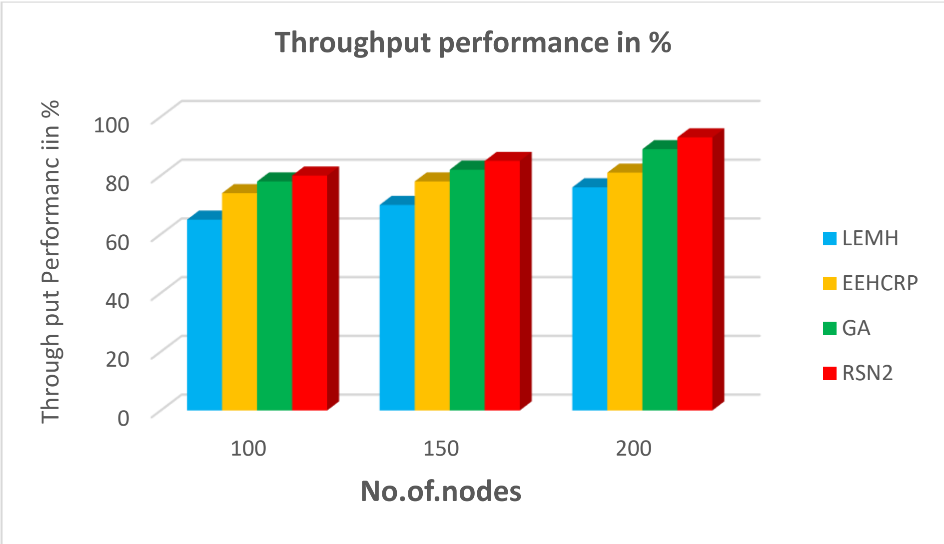

Figure 6. Throughput performance

Figure 6 shows that the LEMH is 76%, EEHCRP is 81%, GA is 89%, and RSN^2 is 93% when throughput performances are compared. The throughput ratio is superior to earlier approaches.

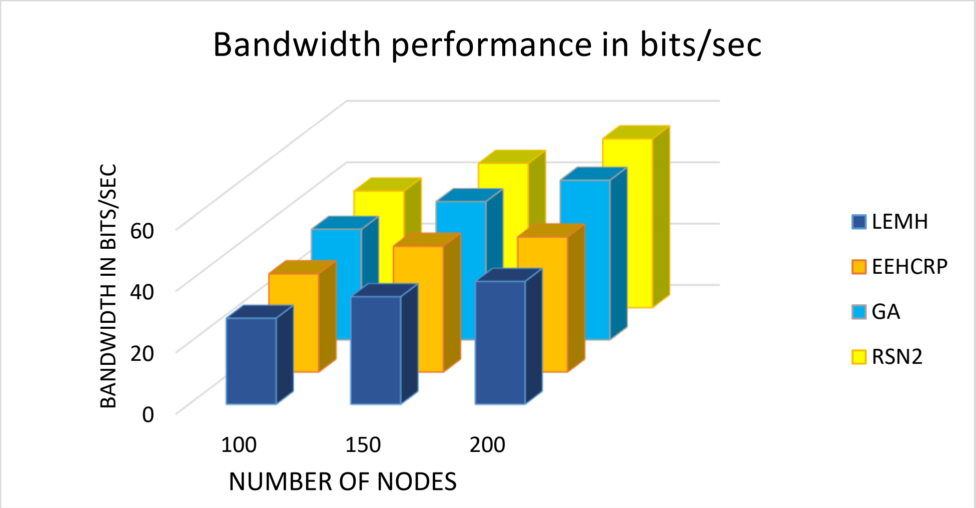

Figure 7 Bandwidth performance

Figure 7 shows that LEMH is 40 bits per second, EEHCRP is 44 bits per second, and Genetic Algorithm (GA) is 52 bits per second when comparing bandwidth performance. Recurrent Spectral Neural Networks (RSN2) have a 55 bits per second bandwidth ratio, which is superior to earlier techniques.

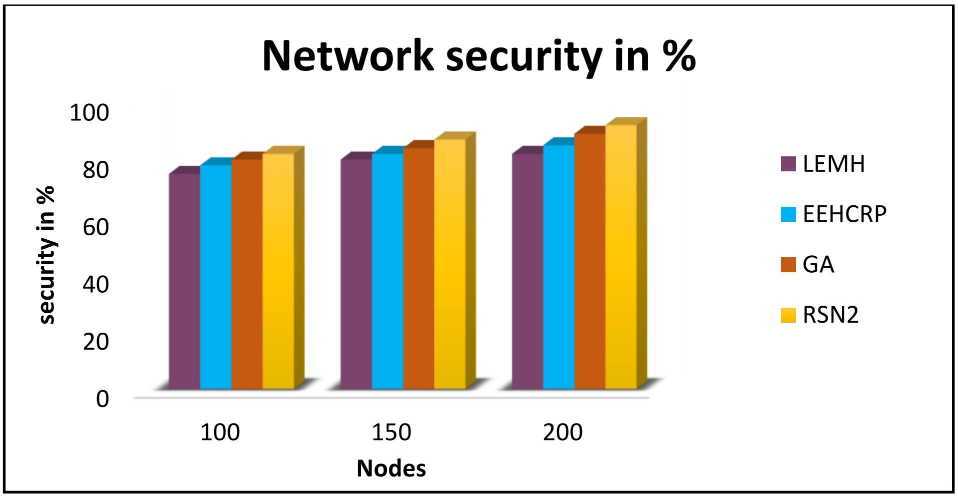

Figure 8 Network security

Figure 8 shows LEMH has an 82% security performance rating, followed by EEHCRP, Genetic Algorithm (GA), which has an 89% rating, and RSN^2, which has a 92% security rating.

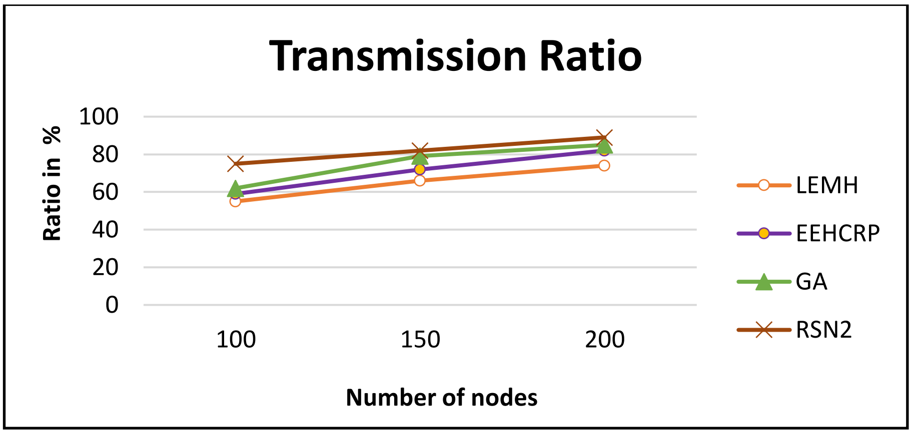

Figure 9: Transmission ratio

Figure 9 shows that LEMH: 74%; EEHCRP 82%; Genetic Algorithm (GA): 85%; Recurrent Spectral Neural Networks (RSN2): 89%;

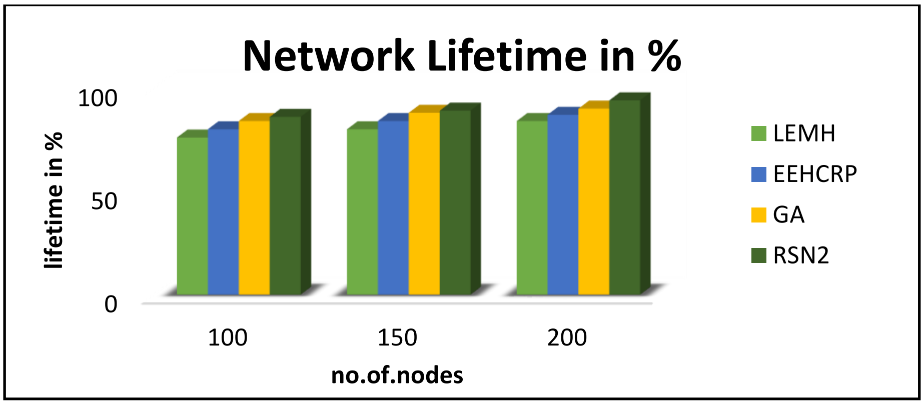

Figure 10: Lifetime of Network

Figure 10 shows that the proposed method increases network lifetime compared to LEMH, EEHCRP, GA, and RSN^2 which has a 94% improvement in security performance.

5. Conclusion

Underwater sensor networks are useful for certain networks, such as energy savings and massive data collecting processes. In this study piece, a significant number of clusters employing 3D architectural papers connected to knowledge in Underwater Sensor Network using Energy Efficient data transfer protocol are analysed. The Energy Efficient data transmission protocol is extremely beneficial for huge data collecting and energy conservation. The increased implementation of UWSNs prompted numerous academics to investigate the energy consumption algorithm that was designed. Second phase, Genetic Algorithm (GA) calculations track down the most limited path for information transmission to avoid delays. The suggested GA rules and TBTL computations improve information mobility and connection security while lowering energy consumption and extending network lifetime. To improve network security and longevity, the third phase includes a safe multipath routing technique Recurrent Spectral Neural Network (RSN^2) for after delivering the notification packet, the CH node waits for acknowledgement and data packets from the cluster members. If a CH node is unable to connect to a cluster member node for an extended period of time, it examines the CT entry for a neighbouring attempt to contact, thinking the cluster member node has left the cluster area. If the CH is unable to interact with any node in the CT, it will enter acoustic mode before delivering an announcement. Cluster nodes feed CH with little quantities of detected data. Programming has successfully implemented the encryption and decryption algorithms, and it has been proved that the suggested method can achieve secure communication. The block-symmetric algorithms will be implemented and evaluated on real underwater sensor nodes in the future.

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