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# Implementation of Novel Method for Energy Efficient and Secure Communication in Underwater Wireless Sensor Network Using Machine Learning

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**ABSTRACT:** Underwater Acoustic Sensor Network (UWASN) is a new technology consisting of sensor nodes and unmanned aerial vehicles (AUVs). single and with base stations. In this project, the Network Simulator 3 (NS3) tool is used to verify the performance of Ad Hoc On-Demand Distance Vector (AODV) routing protocol in underwater acoustic network environment. We use 50 nodes including sensors on scuba divers and AUVs. The signal from the center is sent to the group, making it power efficient. DSSS uses XOR encryption method to encrypt and decrypt data and detect malicious nodes in the signal path. We use performance metrics such as packet switching speed, average end-to-end delay, throughput, and energy consumption of sensor nodes. Determine the speed of underwater symbols using machine learning algorithms. Using underwater parameters such as depth, temperature, salinity and pressure to estimate the hydroacoustic signal transmission rate increases the advantages of our project. In this way, energy saving and safe signal transmission under water are achieved.

## I. INTRODUCTION

Underwater Acoustic Sensor Network (UWASN) is at the forefront of underwater research using sensor nodes and autonomous vehicles (AUVs) to achieve unity, process, and underwater communication. This project uses the Network Simulator 3 (NS3) tool to evaluate the performance of the Custom On Demand Distance Vector (AODV) routing protocol in UWASN. The network has 50 nodes, including sensors on scuba divers and AUVs, and focuses on energy saving signal transmission and strong security measures. In order to enhance the security of signal transmission, direct sequence spread spectrum (DSSS) is used for encryption to prevent any threats when malicious nodes are detected. Transmission is organized into clusters to improve energy efficiency, which is important in limited underwater resources. The system evaluates performance metrics such as packet delivery rate, average end to end delay, power consumption, and power consumption to specifically assess the effectiveness of AODV arrangements under water. A unique aspect of the project is the integration of machine learning algorithms to estimate underwater signal intensity. The machine learning models use underwater measurements such as depth, temperature, salinity, and pressure to improve the adaptability of the network to different situations. This new approachable energy efficient and safe acoustic signal transmission in the underwater environment, potentially impacting many applications in marine research and environmental protection.

## II. OBJECTIVE

The aim of this study is to evaluate the performance of Ad Hoc Optional Distance Vector (AODV) routing protocol in the context of Underwater Acoustic Sensor Networks (UWASN). It plays an important role in efficient and effective communication between smart devices, battery-powered sensors and vehicles. > Use machine learning algorithms to

control the speed of underwater signal transmission based on underwater parameters. This may cause low connectivity area or complete separation, which affects the performance measurement of AODV protocol. Data limitations will limit the accuracy and validity of AODV protocol performance measurements.

### III. LITERATURE SURVEY

However, resource and equipment limitations have led to further research. In relational studies, researchers have proposed two new methods/algorithms to improve the capabilities of AUVs in UWSNs. The first algorithm uses bottom up clustering technique to group the elements of the network according to various communication methods. The aim is to solve each other's limitations by distributing the work process to multiple computers. In the second algorithm, nodes are used in both homogeneous and heterogeneous ways and additional constraints are imposed to have a good effect on real life scenarios. This approach aims to improve the allocation of resources and improve the underwater tracking performance. [1] Underwater Sensor Networks (UWSN) are wireless networks deployed in seas and oceans with limited search environment. This network is used to measure temperature, pressure, water pollution, oxygen levels, electrical activity, floods, and rivers. Although radio frequency (RF) is widely used in wireless networks, it is not compatible with the UWSN environment, so other communication methods such as acoustic channels, weak light, or magnetic induction are adopted to manage underwater sensors. (MWSN) Unlike terrestrial wireless sensor networks, UWSNs are dynamic and sensors move along rivers [2]. This work aims to investigate the use of nodes and data collection techniques and then encourage researchers to create a framework for the use of new nodes and data collection techniques that will be effective in underwater communication. The use of UWSN as well as different types of communication is also part of this paper. Many existing collection systems based on the distribution model are simulated using a network simulator (NS 2.30) to analyze and compare the performance of the state of the art technologies [3].

### IV. EXISTING & PROPOSED SYSTEM

#### 1. EXISTING SYSTEM

Existing methods use the UWSN channel evaluation model and secure LSTM-MAC principles based on Generative Adversarial Network (GAN) to protect data communication. This model uses trained personnel to build an intelligence system (IDS). Monitoring technology, Secure Hash Algorithm-3 (SHA-3), Double Fish Algorithm and packet filtering tools. Traffic access to the correct nodes.

##### 1.1 DISADVANTAGES

GAN-oriented models and LSTM networks can be included, which affect real-time performance. The needs of using the machine will increase the effort. Adjustment for dynamic underwater conditions compared to the reactive AODV protocol.

#### 2. PROPOSED SYSTEM

The proposed system is based on the AODV routing protocol and shows improvements and flexibility to solve the unique problems of the underwater environment. The model is designed for 50 nodes representing underwater divers and sensors in autonomous underwater vehicles. Encryption and decryption using Direct Sequence Spread Spectrum (DSSS), which uses the XOR encryption method to provide secure communication between source and source. The goal is to improve adaptability, security, usability and overall performance. A machine learning algorithm is used to determine the signal transfer rate, taking into account parameters such as underwater depth, salinity, temperature and pressure.

##### 2.1 ADVANTAGES

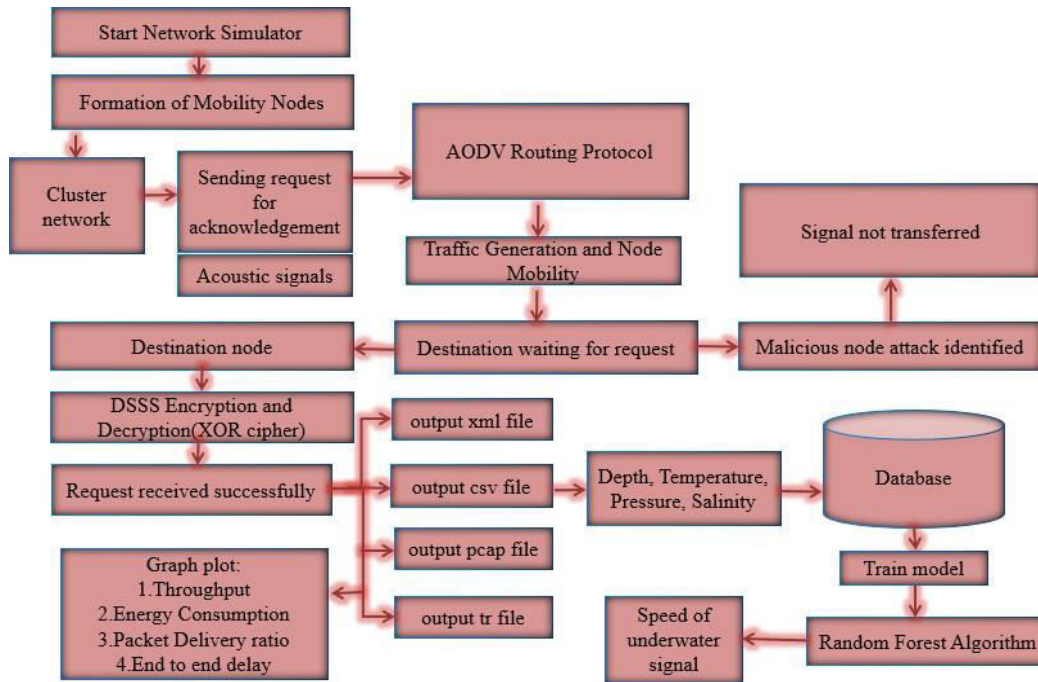
➤ Adaptive routing mechanism provides better and more efficient communication by better adapting to the unique challenges of the underwater environment. Low sensor network behavior. Machine learning for signal speed to ensure that the signal is transmitted effectively from one place to another.



V. BLOCK DIAGRAM

1. SOFTWARE BLOCK DIAGRAM

Fig no: 1 Software block diagram



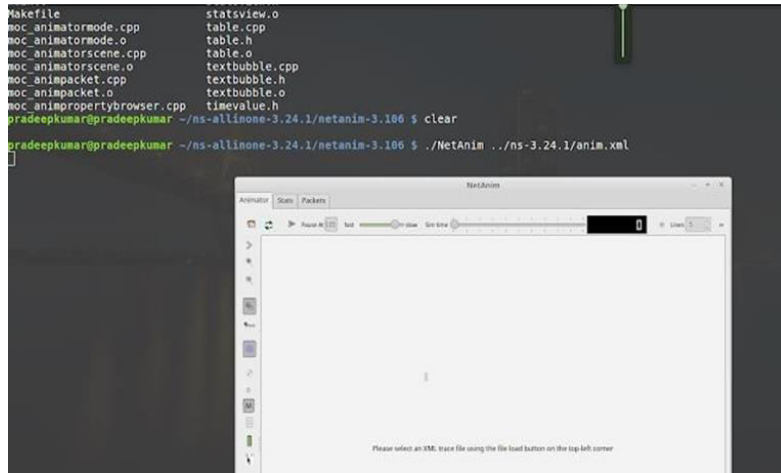
VI. SOFTWARE REQRUMENTS

1. NS3

➤ A network simulator is a tool that simulates a real-world network on a computer, written in C++ or Python. Usually, if we want to do a test and see how our network works using many parameters. We do not have the number of computers and routers required to implement different topologies. Even if we had these resources, creating a test network would be very expensive. Therefore, to overcome these shortcomings, we use NS3, an integrated network simulator for the Internet. NS3 helps to create many virtual nodes (i.e. real-life computers) and allows us to develop hardware, internet products, applications and others for nodes with the help of many groups. Using NS3, we can create point-to-point, wireless, CSMA and other connections between nodes. Point-to-point connection is the same as LAN connecting two computers. Wireless connection is the same as WiFi connection between many computers and routers. CSMA connection is similar to the computer's data bus topology.

2. IMAGE ENHANCEMENT

➤ NetAnim is a web animator that comes with ns3 pre-installed. NetAnim may fail when compiling on ns3. NetAnim with #ns3. Sometimes the above methods may not work, but netanim products definitely will..



**Fig no: 2 NetAnim**

### 3. CAP FILE IN NS3 1.Packet Capture Definition

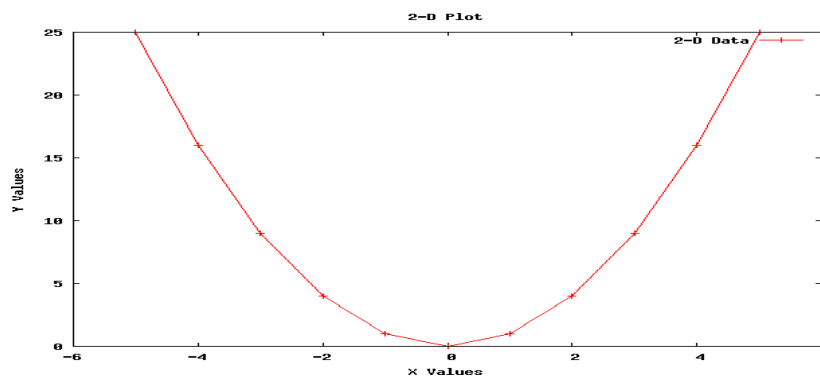
➤ Packet capture is a network application that captures data packets transmitted over a network. Once a packet is captured, IT teams can save it for further analysis. By analyzing these packets, IT teams can identify problems and resolve network issues that are affecting daily operations.

#### Uses of packet capture:

Packet capture helps you analyze your network, identify network performance issues, and manage network connectivity. It allows IT teams to detect intrusion attempts, security issues, network abuse, packet loss, and integration. It allows network administrators to capture packets directly from network computers. This technique is called packet sniffing. Importance of packet inspection. Managing an organization's network is a difficult task. It involves checking the user's IP address, DNS servers, and other security standards to determine the cause of the problem. This is where packet capture technology comes into play. Packet tracers can collect and analyze packet data and quickly troubleshoot complex network problems.

#### GnuPlot on ns3 data collection:

During the ns-3 simulation process, various performance tests and simulation results are collected. These may include metrics such as throughput, latency, packet loss, etc. depending on the specific simulation scenario. This file contains the numerical data that will be used in creating the plot. The script includes instructions on targets, axis labels, titles, and other formatting details. These visualizations help researchers and developers analyze the behavior of simulated networks and draw conclusions based on the results.



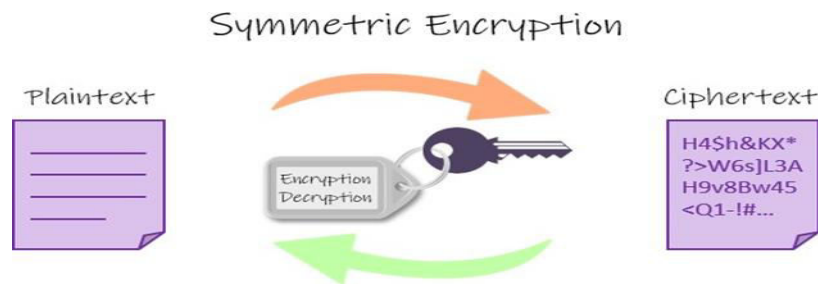
**Fig no: 3 GnuPlot in ns3 Graph plot**

#### 4. AODV Routing Protocol

➤ Here we will go into the details of the AODV reactive routing protocol, which is necessary because it is based on the request routing protocol. Less overhead. In addition, the overhead depends on the level of mobile models in the network. The method is determined when needed. More scalable, but has more routing latency limitations and reduced routing cache for a good number of The path remains unchanged until a packet routing error occurs, which is a change in the network topology that means the packet can no longer be forwarded. There are many other reactive rules such as DSR, ABR, etc. Reactive protocols have less overhead than proactive protocols but respond more slowly to changes in the network topology.

#### 5. CRYPTOGRAPHIC KEY (XOR)

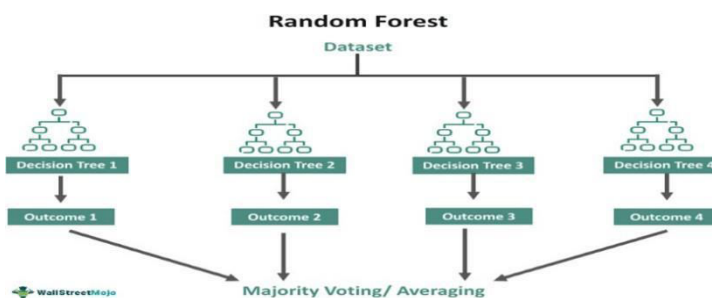
➤ The XOR encryption algorithm is an excellent and easy-to-implement symmetric encryption method. Due to its efficiency and simplicity, XOR encryption is one of the most important complex encryption methods used today. The XOR encryption algorithm is an example of symmetric encryption, where the same key is used to encrypt and decrypt messages.



**Fig no: 4 Cryptographic key is used both to encrypt and decrypt messages**

#### 6. RANDOM FOREST ALGORITHM

➤ Random forest is a widely used classification and regression algorithm. Since classification and regression are the most important aspects of machine learning, it can be said that the random forest algorithm is one of the most important algorithms in machine learning. Predict what the user will buy or borrow. Random forest classifiers are near the top of the classifier hierarchy. Let's start with the definition of the random forest algorithm.



**Fig no: 5 Random Forest Algorithm**

#### 7. SCUBA DIVING

➤ The number of scuba divers around the world has exploded. Diving centers are opening all over the world and hundreds of thousands of people try these centers every year. If you are considering learning to dive, rest assured that scuba diving is easy to learn and can be done by almost anyone. This means balancing the weight of the device with the air in the jacket until you are not in the water or swimming. You will be free from gravity for the first time in your life! For many people, the thought of losing weight is enough to make them go diving. Diving may seem gear-focused at first, but once you get used to your gear and achieve a moderate level of buoyancy, you'll be able to enjoy the underwater world you've just seen.





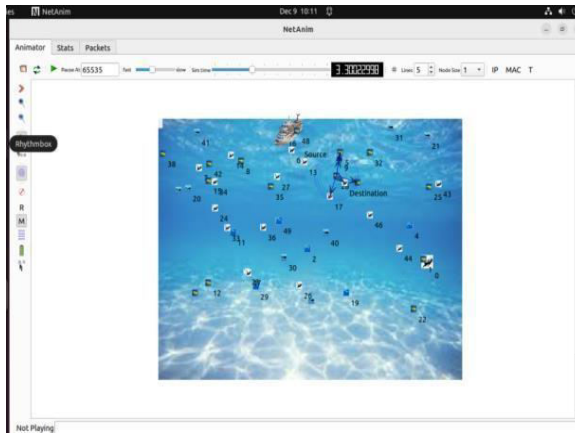


Fig no: 8 Cluster network

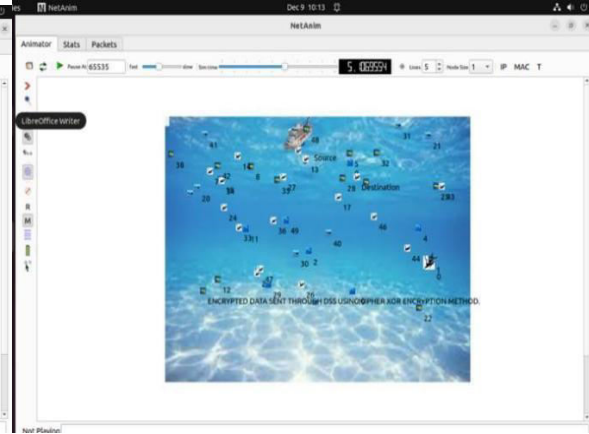


Fig no: 9 Encrypted data sent through DSS

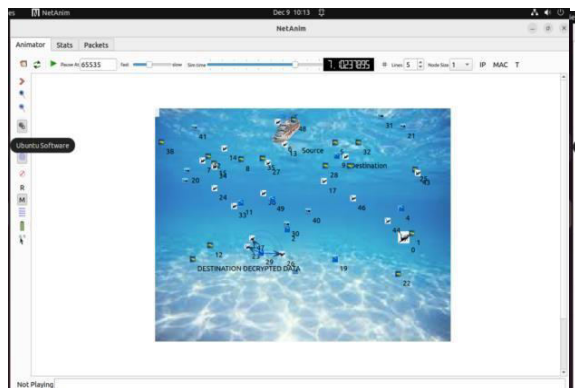


Fig no: 10 Destination decrypted data

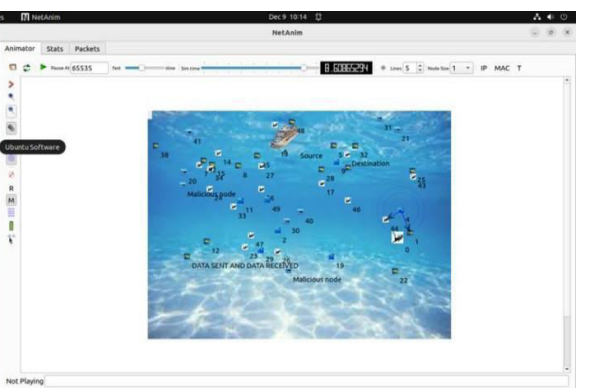


Fig no: 11 Data sent and data received

TraceMetrics - a trace analyzer for Network Simulator 3

File Tools Help

Simulation Nodes Throughput / Goodput Little's Result Streams

Node	Throughput (Bytes/second)	Goodput (Bytes/second)
0	214 226830999999	1812 194255428563
1	214 226830999999	1812 194255428563
2	214 226830999999	1812 194255428563
3	214 226830999999	1812 194255428563
4	214 226830999999	1812 194255428563
5	2125 5025063853325	1812 194255428563
6	2125 9052181988084	1812 194255428563
7	2183 492722529904	1812 194255428563
8	2157 3165832889513	1812 194255428563
9	2125 5025063853325	1812 194255428563
10	2183 492722529904	1812 194255428563
11	2172 8195589990484	1812 194255428563
12	2157 3165832889513	1812 194255428563
13	2131 140444047999	1812 194255428563
14	2182 55181137418	1812 194255428563
15	2188 727950378094	1812 194255428563
16	2440 8243087801893	2031 2884050979037
17	2131 140444047999	1812 194255428563
18	2157 3165832889513	1812 194255428563
19	2131 140444047999	1812 194255428563
20	2178 257494881713	1812 194255428563
21	214 226830999999	1812 194255428563

Fig no: 12 Tracemetrics

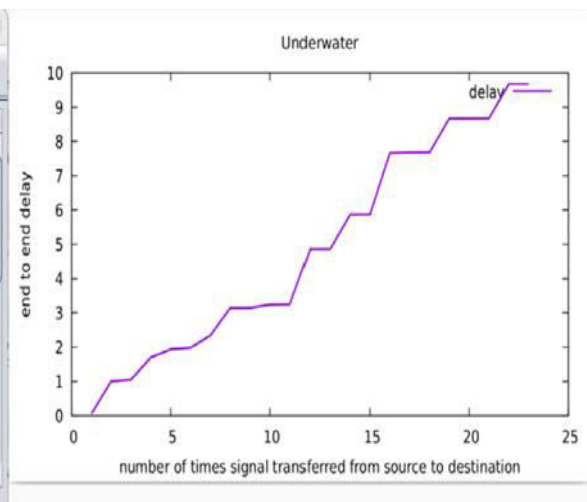


Fig no: 13 Graph-end to end delay



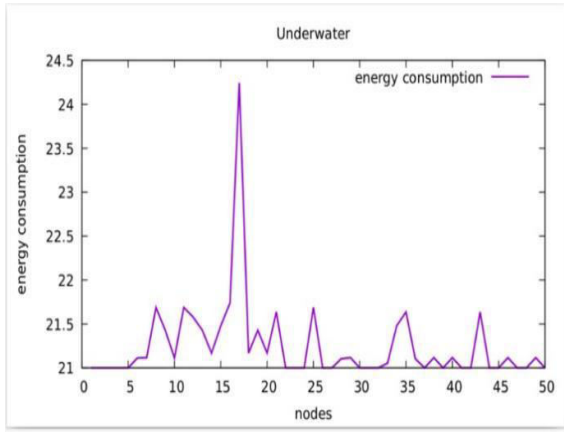


Fig no: 14 Graph-energy consumption

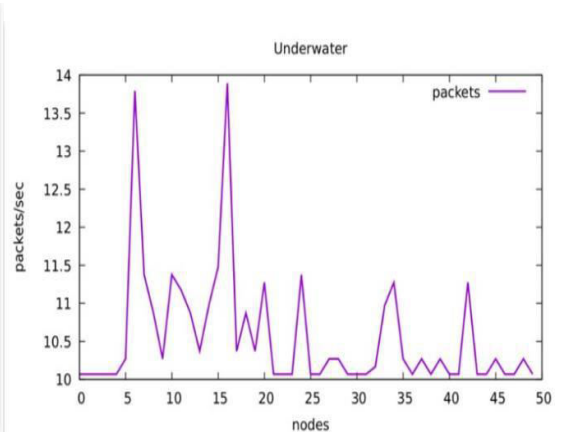


Fig no: 15 Graph-packet delivery ratio

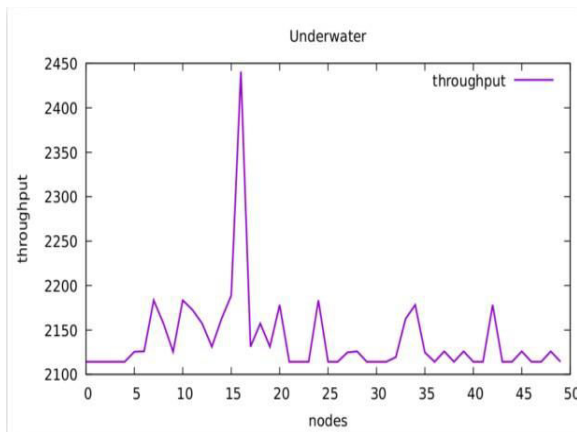
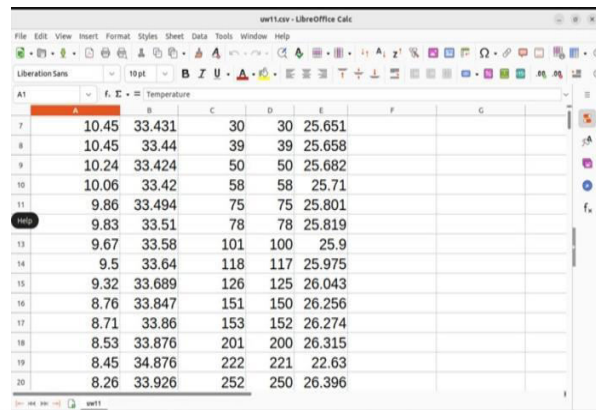


Fig no: 16 Graph-throughput



	A	B	C	D	E	F	G
7	10.45	33.431	30	30	25.651		
8	10.45	33.44	39	39	25.658		
9	10.24	33.424	50	50	25.682		
10	10.06	33.42	58	58	25.71		
11	9.86	33.494	75	75	25.801		
12	9.83	33.51	78	78	25.819		
13	9.67	33.58	101	100	25.9		
14	9.5	33.64	118	117	25.975		
15	9.32	33.689	126	125	26.043		
16	8.76	33.847	151	150	26.256		
17	8.71	33.86	153	152	26.274		
18	8.53	33.876	201	200	26.315		
19	8.45	34.876	222	221	22.63		
20	8.26	33.926	252	250	26.396		

Fig no: 17 Csv dataset for machine learning

```

es Terminal Dec 9 10:57
makelabs@Ubuntu: ~/underwater

/home/makelabs/ns3/ns-3.36.1/build/include/ns3/animation-interface.h:315:8: note
: candidate expects 6 arguments, 1 provided
gmake[2]: *** [scratch/CMakeFiles/scratch_testing.dir/build.make:76: scratch/CMa
keFiles/scratch_testing.dir/testing.cc.o] Error 1
gmake[1]: *** [CMakeFiles/Makefile2:16476: scratch/CMakeFiles/scratch_testin
g.dir/build.make:24] Error 2
Files *** [Makefile:146: all] Error 2
makelabs@Ubuntu:~/ns3/ns-3.36.1$ cd ../../
makelabs@Ubuntu:~$ cd underwater
makelabs@Ubuntu:~/underwater$ python speed.py
Command 'python' not found, did you mean:
  command 'python3' from deb python3
  command 'python' from deb python-is-python3
makelabs@Ubuntu:~/underwater$ python3 speed.py
/usr/lib/python3/dist-packages/scipy/__init__.py:146: UserWarning: A NumPy versi
on >=1.17.3 and <1.25.0 is required for this version of SciPy (detected version
1.26.2
  warnings.warn(f"A NumPy version >={np_minversion} and <{np_maxversion}")
Enter Depth in m : 10
Enter Temperature in celcius : 30
Enter Salinity in grams per kg of water(g/kg) : 10
Enter Pressure in N/m2 : 13
The speed of underwater signal transfer = 23.752 kb/s
makelabs@Ubuntu:~/underwater$

```

Fig no: 18 Predicting speed of underwater signal

### VIII. CONCLUSION

The human-computer interaction (HCI) system proposed in this project uses facial movement tracking as an alternative to mouse input. The system simulates facial movements to control the mouse cursor and detects the user's face for the clicking action, enabling hands-free and intuitive operation. This system provides great benefits with improved usability that overcomes the limitations of current technology, unlike existing business solutions. By connecting the face map, the system not only transforms the facial expression into a moving cursor, but also tries to track the user's context and skills. It is good that the application will include computer vision and image processing algorithms to provide real-time monitoring of the eyes of the network camera area, creating a more inclusive and efficient environment. This project is an Arduino Mega 2560 microcontroller used to take notes from touch sensors, facilitating a new communication method to connect to a PC.

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