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Security and Integrity Aware Deep Learning Based Approach for Wireless Communications

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Abstract— The Underwater Acoustic Based Networks are vulnerable and susceptible towards number of natural as well as technical aspects which consume huge amount of energy and therefore it affects the lifetime. A number of approaches are devised so far for the enhancement of lifetime and performance factor of underwater networks, still there is huge scope of research. In this research work, a novel and effective integration of deep learning for energy optimization and performance enhancement is proposed to be implemented. The results in the work depict the proposed approach effectual and optimized in assorted parameters. This work focus on the integration of cloud technologies so that the detailed log of communication can be established, trained and then predictive analytics can be done.

Keywords— Energy Optimization, Underwater Wireless Sensor Networks, Fuzzy Based Energy Aware Protocol, Energy Harvesting, Multilayered Energy Optimization

I. INTRODUCTION

Underwater Acoustic Communications (UAC) [1] is one of the prominent approaches having communication at the bottom or intermediate level in the ocean. For military and security applications, there is need to deploy the submarines below the water level of sea and there is regular communication with the base stations and control points at military base so that the movements of enemies and other objects can be visible very clearly [2]. By this approach, the prior and appropriate can be taken. As energy and power optimization are key issues, therefore it is required to develop the effective approaches so that the lifetime can be improved and communication can be established for long time.

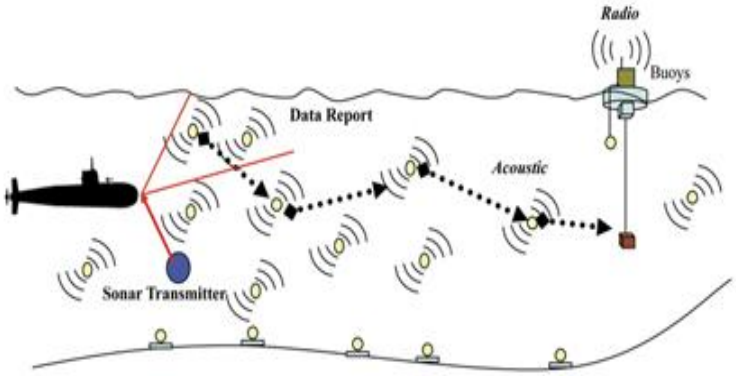

Figure 1 – Underwater Sensor Network

II. MODULES WITH UNDERWATER SENSOR NETWORKS

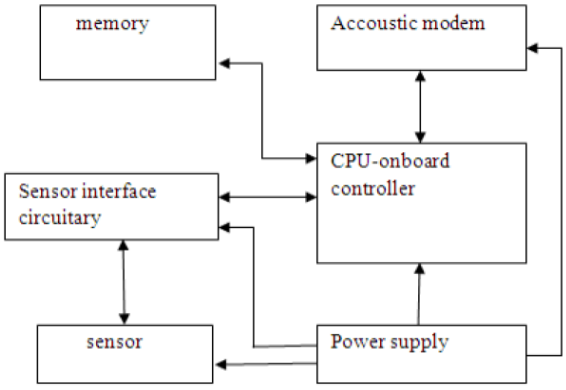

Figure 2 – Components in UWSN

The overall architecture and hierarchy of modules in UWSN typically having multiple nodes with Internet of Things (IoT) [3] compatibility, satellite, user and the base station.

Modulation is one of the classical approaches that is used for the filtering, transmission and effective communication in the sensor networks. There are number of approaches involved for the integration of modulation with underwater acoustic communications (UAC) including the following [4] -

- Frequency and Pulse-position modulation (FPPM and PPM)
- Frequency Shift Keying (FSK)
- Phase Shift Keying (PSK)
- Direct Sequence Spread Spectrum (DSSS)
- Frequency Hopped Spread Spectrum (FHSS)
- Multiple Frequency Shift Keying (MFSK)
- Orthogonal Frequency-Division Multiplexing (OFDM)

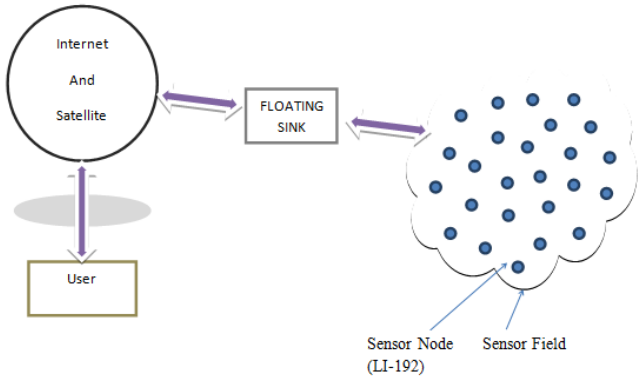

Figure 3 - Architecture of Sensor Network

Following are the typical components in a sensor node which work together so that effective and regular communication can be established.

- Processing Unit (PU)
- Data Sensing Unit (DSU)
- Transmission Unit (TU)
- Energy Unit (EU) or Battery

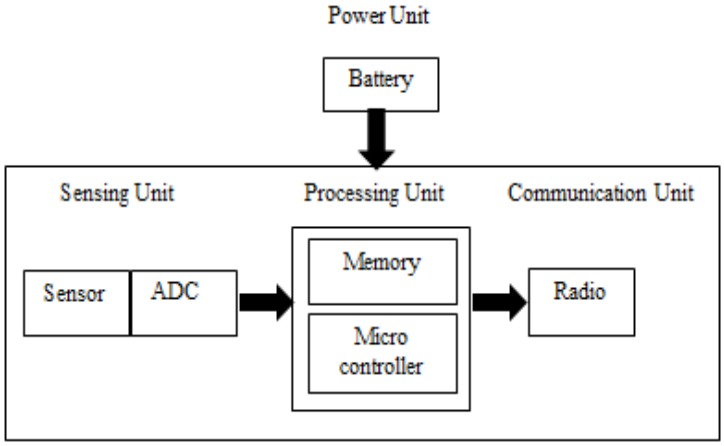

Figure 4 - Architecture of Sensor Node

III. PROPOSED WORK AND RESULTS

This work is having key focus on assorted technologies including cloud and deep learning [4] so that prior and effective analytics can be done. With the integration of virtualization based cloud, the performance of AUC can be escalated a lot. In current era, the domain of Cloud Computing and Distributed Applications are key domains of research from last decade and number of algorithms and approaches devised so far in the sub domains of multiprocessor architectures and high performance computing [5]. Various algorithms and approaches including nature inspired algorithms are developed and implemented to cope up the issues of performance and effectiveness [5].

The major areas of research in grid and cloud architecture are -

- Load Balancing
- Power Optimization
- Energy Optimization
- Secured Routing

- Task Scheduling
- Confidentiality and Integrity Management
- Public and Private Key Cryptography and many others

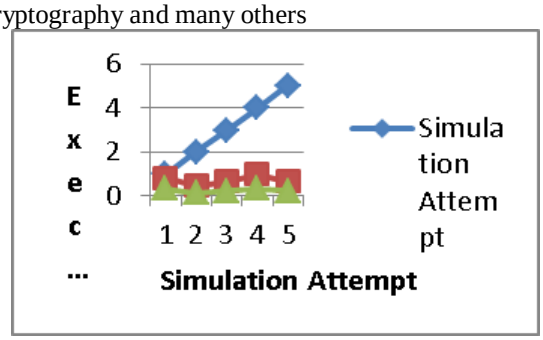

Figure 5 - Line Graph Analysis of the Classical and Proposed Approach

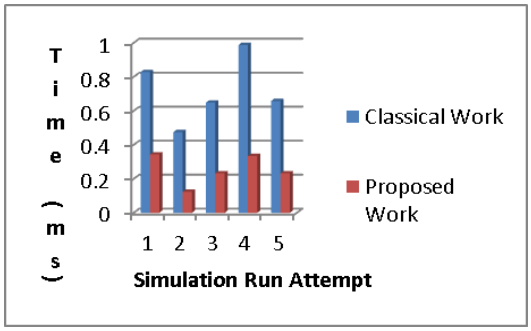

Figure 6 – Bar Graph Analysis of the Classical and Proposed Approach

Simulation Attempt	Classical Work	Proposed Work
1	89	70
2	78	60
3	67	59
4	76	40
5	49	20

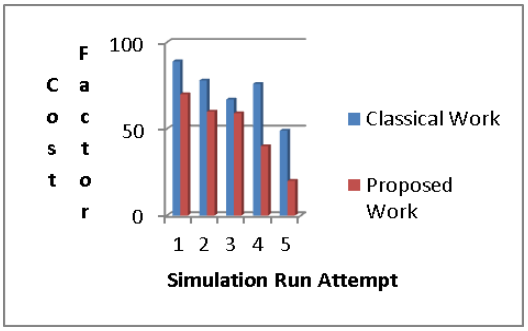

Figure 7 – Cost Factor Graph Analysis of the Classical and Proposed Approach

Classical / Existing Approach is not having effectiveness and efficiency as compared to ANN based approach. The classical work is taken as the implementation without integration of metaheuristic based simulation [3].

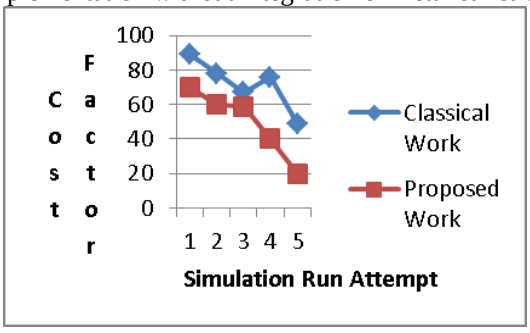

Figure 8 – Cost Factor Line Graph Analysis of the Approaches

It is evident from the graphical results that the cost factor in the proposed research approach that is very less when compared to the existing algorithmic approach. The execution time in the classical work is taking higher units as compared to the proposed work.

Tasks executed without ANN and then with the integration of ANN to evaluate the efficiency and related cost factor.

Table 4.3 – Difference between Classical and Improved Approach

Existing Base Work (Overall Effectiveness)	Proposed Approach (Overall Effectiveness)
50	60
60	88
70	89
50	69

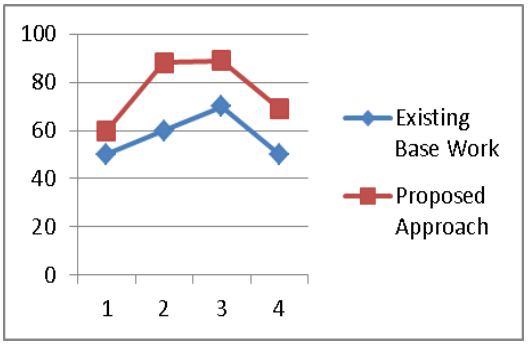

Figure 9 – Effective Comparison of Classical and Proposed Algorithm

IV. IMPLEMENTATION USING MATLAB ANN TOOLBOX

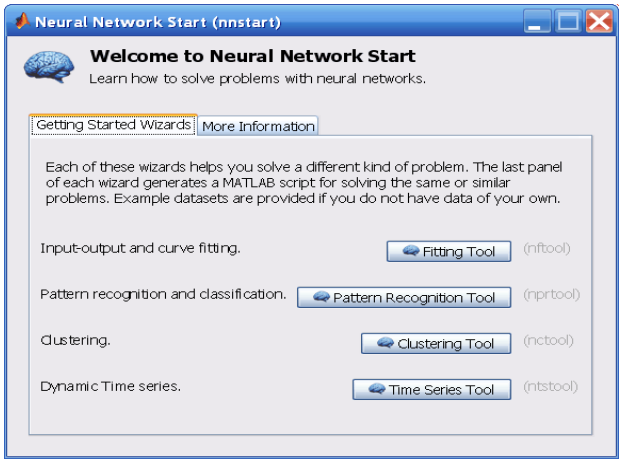

Figure 10 – Neural Network Toolbox in MATLAB

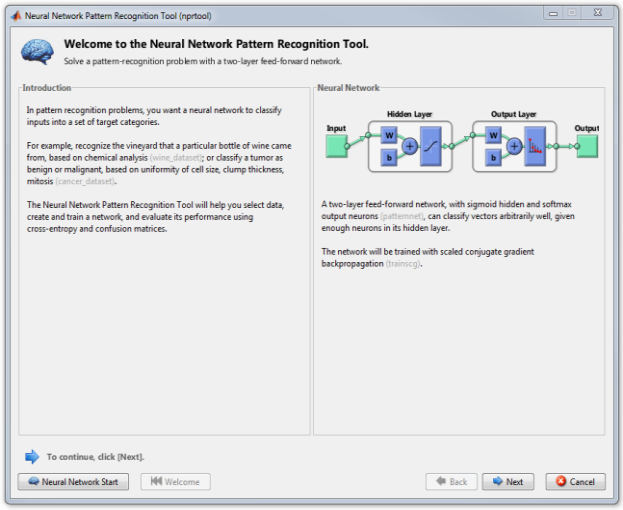

Figure 11 – View Neural Network Pattern Recognition Toolbox in MATLAB

Key Aspects of Implementation

- Training of the network is done using multiple neurons in increasing order so that the performance factor can be evaluated at each phase.
- Logging of various factors and parameters for efficiency evaluation
  - MSE
  - Accuracy
  - Test Accuracy
  - Training Accuracy
- Evaluation of input-target based on random and unbiased epoch to have the accurate and unbiased output.

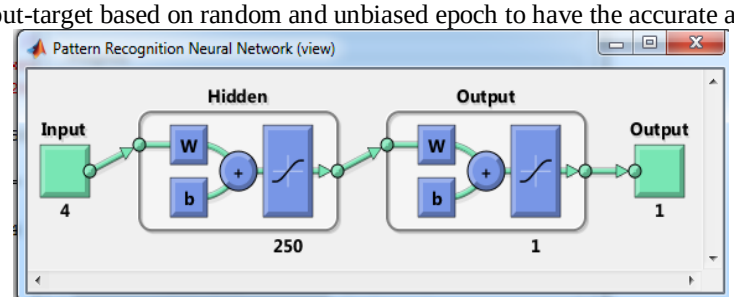

Figure 12 – Best Optimal Training Architecture of ANN.

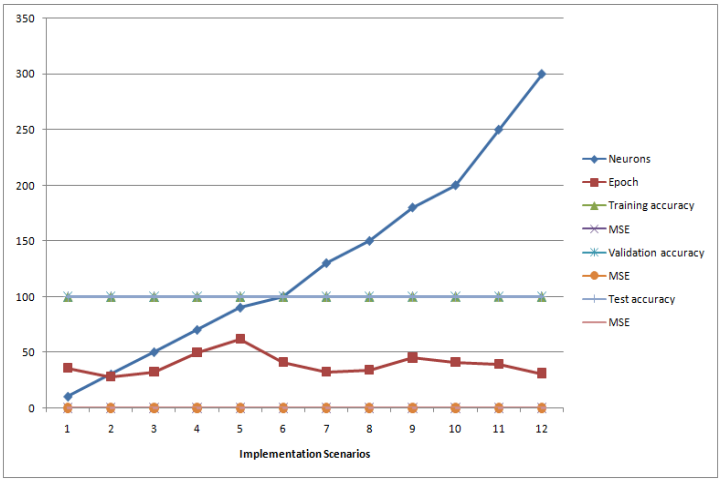

Figure 13 – Cumulative Analysis of parameters in implementation

While training the network the accuracy is highest (100%) with 250 neurons and very less error factor.

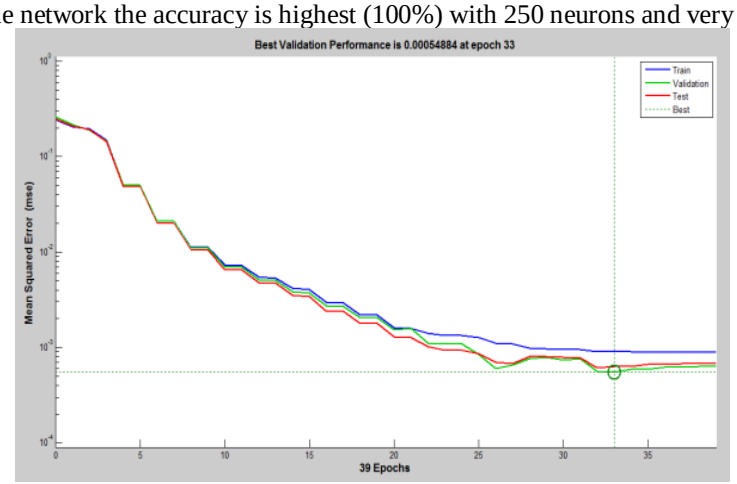

Figure 14 – Performance Plot of the Optimal and Higher Efficiency ANN Model

On the confusion matrix plot, the rows correspond to the predicted class (Output Class), and the columns show the true class (Target Class). The diagonal cells show for how many (and what percentage) of the examples the trained network correctly estimates the classes of observations. That is, it shows what percentage of the true and predicted classes match. The off diagonal cells show where the classifier has made mistakes. The column on the far right of the plot shows the accuracy for each predicted class, while the row at the bottom of the plot shows the accuracy for each true class. The cell in the bottom right of the plot shows the overall accuracy.

The values in the above confusion matrix represents very less or null equivalent values in the false positive and false negative blocks which shows that the dataset is accurate for predictions and there is no ambiguity.

V. CONCLUSION AND SCOPE OF FUTURE WORK

In the research work and algorithm presented and implemented, the results are very effective and better than the greedy method. The proposed approach can be further enhanced using nature inspired algorithms which can give the global optimization results.

In addition and for further improvements, the nature inspired approaches and soft computing approaches can be used to achieve the global optimization.

As deep Learning is one of the constituent of soft computing having core tasks associated with classification, recognition which are generally related with the artificial intelligence. Generally, these operations are performed using some metaheuristic approach in which the global optimization or simply effective results can be fetched from a huge search space of solutions.

The prominent soft computing approaches which can be used for further optimization include

- Fuzzy Logic
- Support Vector Machines
- Swarm Intelligence
- Metaheuristics
  - Ant Colony Optimization
  - Cuckoo Search
  - Bees Algorithm
  - Particle Swarm Optimization
  - Firefly Algorithm
  - Bat Algorithm
  - Simulated Annealing
  - Flower Pollination Algorithm
- Bayesian Network
- Evolutionary Approaches
- Nature Inspired Algorithms
- River Formation Dynamics

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