Study of Applications of Artificial Neural Networks

Kaleem Ullah Moon^{1*}, Shahan Yamin Siddiqui², Bilal Shoaib Khan³, Irfan Abbas⁴, Abdul Hannan Khan⁵, Muhammad Sohail Irshad⁶, Muhammad Sajid Farooq⁷

^{1,2,3,4,5,6}Department of Computer Science, Minhaj University Lahore, Lahore, Pakistan.

^{2,5,7}School of Computer Science, National College of Business Administration and Economics, Lahore, Pakistan.

⁴Department of Computer Science, University of Central Punjab, Gujrat, Pakistan.

¹kaleemullah987@gmail.com

Abstract

This study is related to the different methods of identification of artificial neural networks. These techniques assess and detect lung cancer in the early stage of life, therefore, preventing lung disease. Growth in lung cancer is Pakistan's principal cause of death, so early identification of lung disease is crucial. The position and expectation of growth of lung cancer is guided by the pre-treatment plan in which sections, smoothing, and improvement measures were prepared which includes procedures based on pictures and steps. Lung malignancy was linked to the proper model of the false neural system and paces of the endurance of patients with lung disease were also determined. The role of artificial neural systems in the medical profession is significant. Nowadays most ailment treatment strategies are prepared to upgrade the yield display with the aid of man-made brainpower. The artificial neural network model is useful in lung cancerous growth disorder because lung type of cancer can be detected. The main aim of this paper is to study the different methods of artificial neural network techniques used to detect, assess, and treat patients with lung cancer.

Keywords: Artificial Neural Network (RNN), Artificial Intelligence (AI), Application of Neural Networks (AoNN), Back-Propagation (BP).

1. INTRODUCTION

Artificial intelligence is the branch of computer science, which contributes to the development of smart systems in which humans can operate and react. This is a non-linear neural system inspired by the structure, behavior, and intellectual capacities of the biological

brain.

1.1 Artificial Neural Networks (ANN's)

The term "nervous system" derives from the discovery of artificial intelligence (AI), which seeks to understand and express the use of the

human mind. It is also use for building intelligent machines, especially individual-person frameworks. Over the years, pseudo-neural systems have proven themselves to be a complex problem in many areas. The information layer, the hidden layer, and the yield layer are the layers of the pseudo-nervous system. Shaded layers work in the middle of road calculations to obtain the desired yield from the various sources of information

obtained. For design approval applications, the mastery of the neural systems depends on the learned learner computation. Administrative learning has the right direction for every contribution to the system, and directional learning resulting from previous assumptions and theories; In fact, half of the actual resulting frameworks are not well-known and include controlled, unhelpful learning [1].

Figure 1: Artificial Neural Network

1.1.1 Biological Neural Networks (BNN)

There are a billion cells in the human brain linked to each other for the processing and transmitting of information. Each cell line is the general processing unit and the nervous system's main components. The communication between these simple processing units makes it very difficult to maintain.

These initial biological neurons are created by biological neural networks that make connections with other neurons and transmit signals between them. Some impulses in the central nervous system control brain function.

Artificial neural networks are made up of interconnected artificial neurons that rely on biological neurons interacting within the human nervous system. Artificial neural networks can be used to understand human brain behavior or to solve complex issues [2].

1.1.2 Elements of Artificial Neural Networks (EANN)

A neuron is the basic building block of an artificial neural network. Whether used in a neuron input, output, or hidden layer, its components are valid. It consists of three layers: activation, learning, and load. These layers contain neurons that are interconnected to form a network.

1.1.2.1 Input Layer (IL)

There exist issues with the input layer vector attributes. The generated functions are passed on to the neural network input layer. It has numerical values. Function vectors are to be chosen with great observation. It can interpret the information correctly and does not contain any unnecessary information or incorrect data; otherwise, the overall network output will be reduced. In short, the information is provided by the input layer and forwarded for further processing [3].

1.1.2.2 Hidden Layers (HL)

The hidden layer collects input layer data and executes all practices. Hidden layers can differ from one network to one of our choices. The number of layers concealed depends on the problem's complexity and scale. The number of hidden layers should be used for each problem and results should be set to the final value.

1.1.2.3 Output Layer (OL)

The Led output layer collects the data extracted from secret layers and returns the result to the external user. Here the output of the layer depends upon the outcome of the layer problem. For example, if identification is the problem, the output of the layer returns the number of the layer class.

1.1.3 Activation Function (AF)

The activation function demonstrates excellent flexibility and has a powerful influence on neural network behavior. The weighted input to get the output

response is implemented using the activation function. The activation function is an abstract describing the rate at which the cell shoots. Most neural networks deliver layer output through activation functions. Activation steps within reasonable limits the performance of the neural network. The same activation mechanism is used for neurons in the same sheet. The most commonly used activation functions are:

Figure 2: Identification Function

Linear Activation Function: These tasks are used in one-layer networks

Detection Function: The detection function expression is given by the equation $F(x) = x$. The output of all x is a constantly changing value, as shown in the figure. + 5 Indicate $F(x)$ and + 6 Specify the value x .

Binary Step Activation Function: The mathematical expression of the activation function for the binary phase is given by the equation.

$$f(x) = 1 \quad (1)$$

$$\text{if } x \geq x = 0 \quad (2)$$

$$\text{if } x < 0 \quad (3)$$

Where 0 denotes the threshold value.

Figure 3: Binary step Activation Function

Log sigmoid transfer function: The output of this function lies between 0 and 1 range. The output is designed to give to the equation.

$$\text{Log}(n) = \frac{1}{1 + \exp(-n)} \quad (4)$$

Hyperbolic tangent sigmoid activation function: This function of transition increases the yield from -1 to 1. Because it has a derivative, the hyperbolic tangent function is used with gradient-based training methods. The output is calculated by equation.

$$n = \frac{2}{(1 + \exp(-2*n))} - 1 \quad (5)$$

2. LEARNING IN ARTIFICIAL NEURAL NETWORKS (LANN)

A method of learning must respond to various changes, e.g. Weather change. The processing unit can change the behavior of its input/output to accommodate environmental changes. The learning method is also necessary so that weights may be altered in response to changes in input / output during the training phase. Training can be tracked, exploited and improved within artificial neural networks.

2.1 Supervised Learning (SL)

(The following text is heavily blurred and illegible in the original image.)

Figure 4: Supervised learning

At each speed, the input is practical to the X network and the system responds to the outside teacher. The distance between the actual network output (O) and the desired response is useful as an error measurement. The basic purpose is to minimize the difference between actual output and the desired output. Supervised learning is popular in the field of classification and classification issues.

2.2 Unsupervised Learning (UsL)

Only inputs are given in this type of training and the neural network doesn't have the necessary performance. It is also called a non-teacher analysis because no external teachers are present. The network will check for any consistency in this tutorial, and separate the apps. To give the right results the network adjusts its parameters. Unattended learning is often used in clustering, i.e. unattended input organization without past knowledge of the individual classes.

Figure 5: Unsupervised learning

2.3 Reinforcement Learning (RL)

In most cases, for comparison to untrained learning, comprehensive information is available which uses a reinforcement learning approach to handle these situations [3]. Reinforcement is supervised teaching in learning where there is some input from the community. The feedback signal is intended solely as a confirmation (yes / no), not direction, meaning the retort signals only say whether the output is right or not. It does not indicate what the right output is if the feedback signal is wrong.

3. NEURAL NETWORK ARCHITECTURE (NNA)

There exist various neural network (NN) structures. They vary widely in the number of hidden layers, learning methods, and triggering tasks. There are two widely used neural network (NN's) features:

3.1 Feed Forward Neural Networks (FFNN)

The (FFNN) only allow one-way signal that flows from the input node to the hidden node and then to the output node. There is no feedback network or any loop in the (FFNN). Just like other neural networks the perceptron are categories into different layers in feed-forward as well. The input layer and the hidden layer must be linked together and in this scenario the hidden layer can be linked to another hidden layer and it can also be associated to the output layer as well. The transformation of information from one layer to another layer is known as Feed Forward Neural Network (FFNN).

3.2 Feedback Neural Networks (FNN)

In this type of neural system signals travel in both directions and introduce different loops into the network. In this case feedback signals travel from one layer to another layer [4]. Feedback

network systems are energetic, i.e. they can change their current state nonstop till they get a reasonable reply.

Figure 6: Repetitive / responsive neural network.

3.3 *Feed Forward Back Propagation Neural Network (FFBPNN) System*

This neural system is a combination of two different neural network algorithms. The word "Feed Forward Neural System" indicates a system of networks that identifies a design/layout and the word "back propagation" identifies the process of training from the system of neural network [5].

Figure 7: Feed Forward Back-Propagation Neural (FFBPN) System

Back-propagation is a method of oversaw training which means both the input and the wanted output must be given by the network and the actual output to be compared and need to quantify the errors. Back propagation is a measured error mechanism and then adjusts the weight of the neural network and the input range to decrease the mistake.

4. L U N G C A N C E R DETECTION USING ARTIFICIAL NEURAL NETWORK (ANN)

Lung cancer is a condition involving the uninhibited growth of cells in tumor tissues [6]. There are two non-small cell lung cancer, and small cell lung cancer are basic types of lung cancer. The lungs are large so the tumor develops well before there are signs such as cough and exhaustion. The illness is the world's number one cause of death. It is a global disease that grounds 13 percent of deaths in 2008 and increases every year. And diagnosing the disease is critical. Lung Loss of awareness about lung cancer is the foremost cause of lung cancer. Lung cancer deaths are particularly high in Pakistan. It is Pakistan's second-largest illness, responsible for 0.3 million deaths each year. The early discovery of lung cancer is significant for the treatment of lung cancer and is a very challenging problem, as it is not easy to identify cells that overlap with each other. The survival rate of patients with this disorder, however, diminishes with age. Gastric cancer studies result in malignant stomach development, which can develop anywhere within the stomach [7]. If we're talking about the most common cancer form identified worldwide, this is the fourth. The author

developed an ANN's to assess the being rate of gastric lung cancer by analyzing data from a private firm in 436 patients with stomach cancer. They discovered gastric cancer survival rate using the chance of COX proliferation. The author found that the survival rates of patients with gastric cancer were 77.9%, 53.1%, 40.8%, 32% and 17.4% respectively between 2002 and 2007.

The program was equipped with 242 models including 93 patients with lung cancer, 66 patients with pulmonary disease, and 83 private-institution healthy individuals. There are 19 criteria such as smoking, exposure to smoke, cooking fuel, and chemical exposure that have been used to differentiate lung cancer, and lung cancer from natural control and sensitivity, with 98.3% precision and accuracy, 99.5% and 96.9%. The model with six tumor markers used three artificial neural networks to separate lung cancer from gastric cancer, and lung cancer, and sensitivity, precision, and accuracy was found to be 100%, 83.5%, and 93.5%, respectively [7-8].

We are going to discuss the use of two-step back-propagation algorithm, which feeds the promotional cycle forward and backward [8-9]. It can be used to decide whether or not there is breast cancer in patients, if so, to determine its type. First, the author conducted a CT scan for the patient images, then summarized the characteristics of these CT scan images and made a final diagnosis using ANN. The film was graded as being whether it had cancer or not. The input layers express the output layers

during the feed-forward, and the inputs and output values of the output layers are measured in the back propagation and the effects are determined. In this scenario, the predicted prevalence of illness is 90.5% and the safety ratio is 80.9% [10-12].

5. USE OF ARTIFICIAL NEURAL NETWORKS (ANN's)

In the area of management science and organizational analysis, artificial intelligence plays a major role. This allows the computers the ability to use certain principles to act analytically. In forestry, industry, and problem solving, artificial intelligence plays a major role; image recognition, accounting data storage, computer games, and brain tumor study of the MRI [12]. We deal with the use of neural networks in image processing, recognition and crop classification [13]. The ANN model was used for distinguishing between plant and weed types. A total of 80 photos were used to provide training purposes including 40 seeds, maize, and weeds. The Kodak DC50 camera was collected from digital images of maize plants at McGill University and the McDonald campus. Photos were taken from 600 mm high to capture the view of events on Earth from a bird's eye. The maize plant success rate is 80 to 100%, where the weed success rate is 60 to 80%.

Developing cheap temperature and soil moisture sensors mounted on the farm at appropriate locations and spraying water into the fields if the loam temperature rises and the loam moisture is decreased then the specified range [13]. The LM-35DZ sensor was used for water, & the two metal bars were connected together with insulating tape

and acted as a sensor for moisture. The line is used to produce voltage to the sensor and artificial neural networks to account for non-linearity. ANN consists of three layers, inputs, hidden, and output layers. The secret layer consists of two nodes and four neurons, in the last output layer. The fault rate was found to be less than one percent, suggesting the high accuracy rate of that system [14-15].

A mathematical model constructed by the neural networks used for laser cutting. [15-16]. To maximize the required crop quality, a genetic algorithm was used. Computational Insight methods like Swarm Intelligence [17-19] Neural Network [16,18-19], & like Genetic Algorithm [18-20], Differential Evolutionary (DE), Atoll GA [21], Evolutionary Computing [21-22], Deep Extreme Learning Machine [23-24], are strong contender solutions in the field of smart city, Smart health, Fuzzy logic [25-26] wireless communication [27-28] smart energy [29] as well as cryptography etc. Computational Methods are hot research area which is also used in neural networks.

Using artificial intelligence tools, automated decisions are made those help companies use their limited resources to make higher profits. Artificial intelligence systems can help businesses identify risks and opportunities and develop strategies for defense. For specialized applications, natural language analysis, case-based reasoning, decision-making, and human-hazardous activities such as mining, firefighting, and bomb disposal, artificial intelligence has an important role to play.

Artificial intelligence can be used for its independent movement without interruption in robot route planning from start to finish, for that reason the Ant Colony Optimization (ACO) algorithm was used, which is established on the theory that ant follows short paths from one point to the next. Sediment recruitment techniques have been used to address the drawbacks of the optimization algorithm for the ant colony, including the solutions to evaporation, aging, and pheromone sensitivity. This can save money and increase system stability using the ACO algorithm. Simulation techniques using genetic algorithms were used to find objects in a limited area on the network. A team of experts assembled for this reason.

6. CONCLUSION

We conclude that the artificial neural networks apply in medicine, industry, agriculture, the intent of evaluation, the goal of classification, and many other areas. Use artificial neural networks to ensure that reliable, observable, and excellent outcomes are obtained. Training ANNs, applying neural networks, understanding and gathering relevant data, pose a variety of challenges. ANN can treat and check lung cancer and can be beneficial in new fields of the industry too. The efficiency of ANNs can be enhanced by consuming optimization algorithms such as the ACO for ant adaptation.

REFERENCES

- [1] Sharma, R., & Bollavarapu, S. (2015). Data security using compression and cryptography techniques. *International Journal of Computer Applications*, 117(14).
- [2] Mirkin, B. (2019). *Core Data Analysis: Summarization, Correlation, and Visualization*. Cham: Springer International Publishing.
- [3] Naveros, F., Luque, N. R., Ros, E., & Arleo, A. (2019). VOR adaptation on a humanoid iCub robot using a spiking cerebellar model. *IEEE transactions on cybernetics*.
- [4] Hussain, S., Abbas, S., Sohail, T., Adnan Khan, M., & Athar, A. (2019). Estimating virtual trust of cognitive agents using multi-layered socio-fuzzy inference system. *Journal of Intelligent & Fuzzy Systems*, 37(2), 2769-2784.
- [5] Wang, Z., Zheng, L., Du, W., Cai, W., Zhou, J., Wang, J., ... & He, G. (2019). A novel method for intelligent fault diagnosis of bearing based on capsule neural network. *Complexity*, 2019.
- [6] Jäger, G. (2019). Replacing Rules by Neural Networks A Framework for Agent-Based Modelling. *Big Data and Cognitive Computing*, 3(4), 51.
- [7] Ge, M., Jia, Y., Lu, L., Xu, Y., Wang, H., & Zhao, Y. (2020). Propagation characteristics of weak signal in feedforward Izhikevich neural networks. *Nonlinear Dynamics*, 99(3), 2355-2367.
- [8] Ahmed, K., Kawsar, A. A., Kawsar, E., Emran, A. A., Jesmin, T., Mukti, R. F. & Ahmed, F. (2013). Early detection of lung cancer risk using data mining.

- [9] Biglarian, A., Hajizadeh, E., Kazemnejad, A., & Zali, M. R. (2011). Application of artificial neural network in predicting the survival rate of gastric cancer patients. *Iranian journal of public health*, 40(2), 80.
- [10] Pannu, A. (2015). Artificial intelligence and its application in different areas. *Artificial Intelligence*, 4(10), 79-84.
- [11] Yigitcanlar, T., Hewa Heliyagoda Kankanamge, R. N. E., Butler, L., Vella, K., & Desouza, K. (2020). Smart Cities Down Under: Perfo.
- [12] Jinhua, S., Meiling, S., Zhang, Q., Rougang, Z., Luyun, W., & Yu, X. (2020). Alzheimer's disease, mild cognitive impairment, and normal aging distinguished by multi-modal parcellation and machine learning. *Scientific Reports (Nature Publisher Group)*, 10(1).
- [13] Saarnisaari, H., Dixit, S., Alouini, M. S., Chaoub, A., Giordani, M., Kliks, A., & Bhatia, V. (2020). A 6G White Paper on Connectivity for Remote Areas. *arXiv preprint arXiv:2004.14699*.
- [14] Elahi, H., Wang, G., & Chen, J. (2020). Pleasure or pain? An evaluation of the costs and utilities of bloatware applications in android smartphones. *Journal of Network and Computer Applications*, 157, 102578.
- [15] Hamid, S., Mir, M. Y., & Rohela, G. K. (2020). Novel coronavirus disease (COVID-19): A pandemic (Epidemiology, Pathogenesis, and potential therapeutics). *New Microbes and New Infections*.
- [16] Abbas, I., & Muneer, U. (2019). The Prediction of death causes using regression models and moving averages. *International Journal of Data Science and Advanced Analytics*, 1(1), 39-46.
- [17] Areej Fatima, Muhammad Adnan Khan, Sagheer Abbas, Muhammad Waqas, Leena Anum, and Muhammad Asif, (2019), Evaluation of Planet Factors of Smart City through Multi-layer Fuzzy Logic (MFL). *The ISC Int'l Journal of Information Security*. 51-58.
- [18] Siddiqui, S. Y., Hussnain, S. A., Siddiqui, A. H., Ghufraan, R., Khan, M. S., Irshad, M. S., & Khan, A. H. (2019). Diagnosis of Arthritis Using Adaptive Hierarchical Mamdani Fuzzy Type-1 Expert System. *EAI Endorsed Transactions on Scalable Information Systems*, 19(18), 1-16.
- [19] Atta, A., Abbas, S., Khan, M. A., Ahmed, G., & Farooq, U. (2018). An adaptive approach: Smart traffic congestion control system. *Journal of King Saud University-Computer and Information Sciences*.
- [20] Khan, M. A., Umair, M., Saleem, M. A., Ali, M. N., & Abbas, S. (2019). CDE using improved opposite based swarm optimization for MIMO systems. *Journal of Intelligent & Fuzzy Systems*, 37(1), 687-692.
- [21] Khan, M. A., Umair, M., & Choudhry, M. A. S. (2015). GA based adaptive receiver for MC-CDMA system. *Turkish Journal of Electrical*

Engineering & Computer Sciences, 23(Sup. 1), 2267-2277.

[22] Khan, M. A., Umair, M., & Choudry, M. A. S. (2015, December). Island differential evolution based adaptive receiver for MC-CDMA system. In 2015 International Conference on Information and Communication Technologies (ICICT) (pp. 1-6). IEEE.

[23] Ali, M. N., Khan, M. A., Adeel, M., & Amir, M. (2016). Genetic Algorithm based adaptive Receiver for MC-CDMA system with variation in Mutation Operator. International Journal of Computer Science and Information Security, 14(9), 296.

[24] Umair, M., Khan, M. A., & Choudry, M. A. S. (2015, December). Island genetic algorithm based MUD for MC-CDMA system. In 2015 International Conference on Information and Communication Technologies (ICICT) (pp. 1-6). IEEE.

[25] Umair, M., Khan, M. A., & Choudry, M. A. S. (2013, January). GA backing to STBC based MC-CDMA systems. In 2013 4th International Conference on Intelligent Systems, Modelling and Simulation (pp. 503-506). IEEE.

[26] Kashif, I., Muhammad, A.K., Sagheer, A., Zahid, H., & Areej, F (2018). Intelligent Transportation System (ITS) for Smart-cities using Mamdani Fuzzy Inference System, International Journal of Advanced Computer Science and Applications (IJACSA). ISSN: 2158-107X, Vol. 9, No. 2, (pp. 94-105), Digital Object Identifier (DOI):

10.14569/IJACSA.2018.090215.

[27] Asif, M., Khan, M. A., Abbas, S., & Saleem, M. (2019, January). Analysis of Space & Time Complexity with PSO Based Synchronous MC-CDMA System. In 2019 2nd international conference on computing, mathematics and engineering technologies (iCoMET) (pp. 1-5). IEEE.

[28] Asadullah, M., Khan, M. A., Abbas, S., Alyas, T., Saleem, M. A., & Fatima, A. (2020). Blind Channel and Data Estimation Using Fuzzy Logic Empowered Cognitive and Social Information-Based PSO. International Journal of Computational Intelligence Systems, 22(1), 1-9.

[29] Abbas, S., Khan, M. A., Falcon-Morales, L. E., Rehman, A., Saeed, Y., Zareei, M., ... & Mohamed, E. M. (2020). Modeling, Simulation and Optimization of Power Plant Energy Sustainability for IoT Enabled Smart Cities Empowered With Deep Extreme Learning Machine. IEEE Access, 8, 39982-39997.