Advances in Computer Science and Information Technology (ACSIT)
p-ISSN: 2393-9907; e-ISSN: 2393-9915; Volume 3, Issue 6; October-December, 2016, pp. 540-543

http://www.krishisanskriti.org/Publication.html

Artificial Neural Network Applicability in Medical Science

Neha Singh[1] and Naresh Trivedi[2]

[1]Dept. of Computer Science & Enginering, Ideal Institute of Technology Ghaziabad, U.P – 201 003
[2]Dept. of Information Technology Ideal Institute of Technology Ghaziabad
E-mail: [1]ne19ha@gmail.com

Abstract—*Artificial Neural Networks (ANNs) are new computational tools that have extensive utilization in solving many real world problems. An ANN can be referred as a mathematical model or computational model that consists interconnected group of artificial neurons. It processes information through simple uniform units. It can be implemented in any application without any problem. ANNs are modelled on the working principle of human brain. By using this approach scientists have tried to mimic the way human brains function like they learn from experiences, then they learn how to deal with certain types of situations, then they apply learning to the new situations and take decisions. Neural networks have been used in pattern recognition, speech recognition and synthesis, medical diagnosis, drug design, fault detection, robot control and computer vision and environmental related field.*

Because of novelty of ANN and fast development of computer technologies, use of ANN is increasing, particularly for medical applications including medical diagnostic etc. ANNs are widely used for medical application in various disciplines of medical especially in cardiology. ANNs have been used by many authors for modelling in medicine and clinical research. Applications of ANNs are increasing in pharmacepidemiology and medical data mining. The main objective of this paper to evaluate the applicability of ANNs in decision making for medical field mainly in medical diagnostic.

1. INTRODUCTION

Artificial Neural Networks:

In 1943, Warren Mcculloch and Walterpitts first proposed to use artificial neurons. In 1949, Donald O. Hebb formulated the classical Hebbin rule. Neural network often referred as artificial neural network (ANN) are modelled on the working principle of human brain. One type of network sees the nodes as artificial neurons, these are called artificial neural network; these basically consist of inputs, which are multiplied by weights and then computed by a mathematical function which determines the activation of the neurons. Another function computes the output of the artificial neurons.

In 1951, Marvin Minsky was developed a *neurocomputer snark,* which are capable to adjust the weight automatically. But, it was never been practically implemented. In 1956, a well known scientist met at the Dart mouth Summer Research Project, discussed how to simulate a brain and uses the artificial intelligence to simulate the capabilities by means of software. In 1960, Bernard Widrow and Marclan.E.Hoff introduced ADALINE (ADAptive Linear NEuron) they applied neural network to a real world problems. Rumelhant and McClelland proposed a back propagation algorithm in 1986, which uses in ANN for learning the appropriate weights. Since it is one of the most common models used in ANNs and many others are based on it. Therefore, a neural network is defined as a method of determining the weights on the connections (called its training or learning algorithm) and its activation function. There are many different types of training algorithms. One of the most common classes of training algorithms for Feed Forward Neural Networks FFNNs is called Back Propagation. The basic concept is to use the derivation of an error function in order to find the direction that minimizes the error of the network, and then update the weights accordingly.

The basic component of a neural network is the neuron, also called -node‘‘. Fig. 1 illustrates the neural network. There are three layers; input layer hidden layer and output layer. Inputs are represented by a1, a2 and an, and the output by Oj. There can be many input signals to a node. The node manipulates these inputs to give a single output signal. The values W1j, W2j, and Wnj, are weight factors associated with the inputs to the node.

The activation function in artificial neuron in Artificial neural network implementing the Back Propogation algorithm is a weighted sum(the sum of input xi multiplied by their respective weights wji):

$$A_j(\bar{x}, \bar{w}) = \sum_{i=0}^{n} x_i \, w_{ji} \quad (1)$$

Back propagation network is the most commonly used network. In these networks error is back propagated and is fine tuned for achieving better performance.

The objective of this paper is to provide a preliminary understanding of ANNs and answer the why and when these computational tools are needed, the motivation behind their development, and their use in medical issues such as clinical

data and its diagnosis. ANN-based models are applied to medical related field.

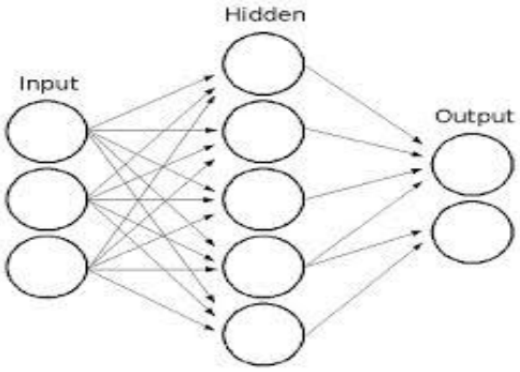

Fig. 1: Artificial Neural Network

2. ADVANTAGE OF ARTIFICIAL NEURAL NETWORK:

Artificial Neural Network are used in science and technology. Neural network have been used in various application areas such as speech recognition, pattern recognition, medical diagnosis, drug design, fault detection, robot control, environmental related field and computer vision. A neural network learns and there is no need of reprogramming. It can be implemented in any application without any problem. When an element of the neural network fails, it can continue without any problem by its parallel nature. Neural model performed better than mathematical models. Now a days ANNs are used for their better output, fastness, error stability and parallel distributed processing. Neural Networks also have broad applicability in real world business problems. They have been applied in many industries successfully. They are used for sales forecasting, customer research, risk management, texture analysis, target marketing, etc. Neural Network can be used for inspecting Paint Quality. Here back propagation type of network can perform quality-scoring operation. A system using back propagation is developed for paint quality which can perform quality-scoring operation. Neural Network can also be used in NET talk. NET talk was created in 1980's to explore the mechanism of learning to correctly pronounce English text.NETtalk assumes that the letter are preclassified and recognized and then the letter sequences from words are learned to the system. NET talk learns proper association between the sequences of letter appears. Thus NET talk is capable of transforming a written English text in to its individual sound type and then pronouncing it using a voice synthesizer. Neural Network is currently a hot research area in Medicine. Neural networks are ideal in recognizing diseases using scans because there is no need to specific algorithm on how to identify the disease. Neural Networks can do by learning with examples. While training the system efficient examples should be selected so that the system can perform reliably and efficiently.

3. ARTIFICIAL NEURAL NETWORK LEARNING AND TRAINING METHODS:

Now a day, there are high speed digital computers which have made their jobs more feasible and new training techniques are developed for more sophisticated network architectures. There are various view of Neural Nets, it can be specialised as mathematical model or piece of computer hardware or computer software. In 1970, Mendel and McClaren has given definition of learning as "learning is a process by which the free parameters of a neural network are adapted through a process of stimulation by the environment in which the network is embedded. The type of learning is determined by the manner in which the parameter changes take place".

ANN can be divided into three main classes, one is learning with teacher or supervised learning and another is learning without teacher or unsupervised learning and Reinforced learning. Supervised learning techniques, which are used most commonly, associate inputs with learned outputs. For supervised learning, a network is trained rather than programmed. In this type of network is trained by providing it with input and matching output patterns. These input-output pairs are provided by the system which contains the neural network which is self supervised. These network are trained by the process of back propagation, although alternative processes, such as cascade correlation and general regression are available. In back propagation training. A technique first introduced by Rumelhart et. al., (4) in 1986, Network is trained using gradient descent method and error calculated is sent back to both hidden layer and output layer for weight adjustments. Error back propagation algorithm works in two passes. Forward pass, it takes input vector computes function and evaluates derivates of error function with respect to weight and other is backward pass, it propagates the error derivates backward and computes the weight adjustment. After training the network, testing for learning and generalization, rather than memorization is performed by using a test set. Unsupervised learning is generally used for database classification. In unsupervised learning, there is no priori information available through which the neural network can check the output it is giving is correct or not. In Reinforced learning is considered as the intermediate of supervised learning and unsupervised learning. This network tells whether the output given by the neural network is correct or incorrect. This information help in learning process and further actions are taken i.e; weight adjustments are done to find the correct outputs. Neural Network provides an approach to data analysis that uses mathematical pattern recognition. Artificial Neural Networks learn complex interactions among inputs and produce an output as they train on a known set of data.

4. APPLICABILITY OF ANN IN DECISION MAKING MEDICAL SCIENCE:

There are several reviews in applicability of ANN in medical diagnosis. Many papers have been published. (Fillipo Amato,

Alberto Lopez) present the general philosophy for the use of ANNs in diagnostic approaches In the medical science, the applicability of Artificial Neural Network is used for medical diagnosis, for cancer, thyroid etc. ANNs have been shown to use various primary data, ranging from clinical parameters to biochemical values, and provide increased diagnostic accuracy for various kinds of disease. For applying ANN in medical science field we first experience the patient data create a patient data sets and normalize these data sets, cleaning these data sets before trained these data sets after this we predict the output of these data sets and collect the value and then normalized these datasets between 0-1.

We show the flow chart (Fig. 2) of ANN analysis for the clinical data for a certain disease. The networks receive a patient's data and create data sets and then select the specific features from the provided information from different health conditions of the patients. After that trained these data sets using the training algorithm (back propagation algorithm) and validate the data sets. Then the network can be used in practice for the prediction of a diagnosis. These steps are shown in the diagram:

- Pre-processing Data
- Create Data sets
- Feature selection
- Train Data set
- Validation
- Prediction

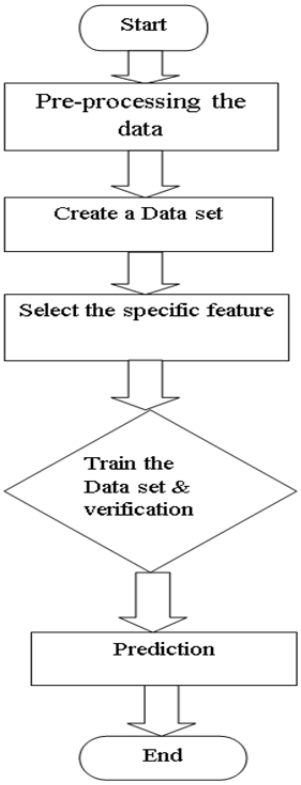

Fig. 2: Flow chart of ANN analysis for clinical data

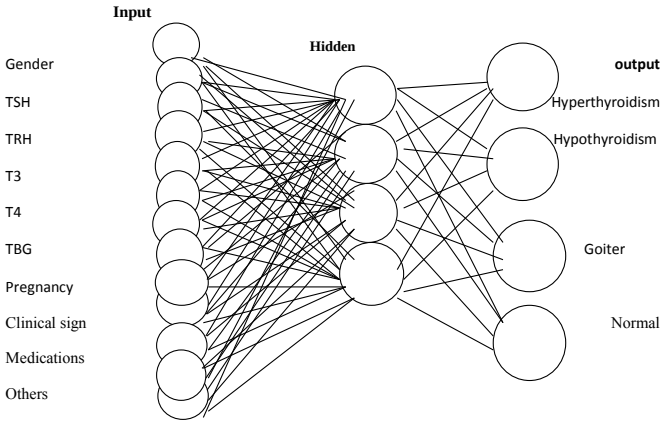

Fig. 3: A Neural Network for Thyroid Diagnosis.

In 1996, Lucilo ohno-Machado and their committee describe the overview of the advances in the application of Artificial Neural Networks to the field of diagnosis. They experiment in various disease such as cardiovasalar disease, cancer, diabetes Thyroid diagnosis and many more. There is an example of applicability of Artificial Neural Network in Thyroid diagnosis. They experiment a set of 9172 patients suspected of having a thyroid disease from the data repository at the University of California. Diagnostic tasks usually require classification of cases for one-time point, while prognostic task may require the assessment of a patients' status over time. Using of hierarchal Neural Network (HNN) can improve performance in a medical diagnostic task. Classification performance of HNNs was better. Thyroid diagnosis is based on interpretation of clinical & laboratory findings. Through the hormones it produces the thyroid gland influences almost all of the metabolic processes in the body. Thyroid disorder can range from a small, harmless goiter that needs no treatment to life threatening cancer. The most common thyroid problems involve abnormal production of thyroid hormones. Too much thyroid hormone result in a condition known as Hyperthyroidism. In sufficient hormone production leads to hypothyroidism. These are two classes of thyroid disease one is hyperthyroidism and another one is hypothyroidism. In the network, four conditions (output) occurs Normal, Hypothyroidism, Hyperthyroidism, other conditions as shown in Fig. 3. In the diagram there is input nodes and a hidden layer where weights are adjusted and gives the corresponding outputs.(condition).And a common thyroid disorders are Hashimoto disease, Graves disease, Goiter, and Thyroid Nodules in which hashimoto disease, Graves disease and Goiter are Hyperthyroidism. These thyroid disorder can be evaluated in another Hyperthyroidism Network.

5. SUMMARY

Artificial Neural Network are computer based tools. Neural Network technique has been widely applied to problems in

engineering and computers. Recently, medical applications have been developed in various fields in thyroid diagnosis, clinical etc. The back propagation algorithm has been used in the vast majority of application in the field of medical science. In back propagation network error is back propagated and is fine tuned for achieving better performance. The training and test sets are used to avoid over fitting. With all the studies done on ANN it can be derived that much has been done to exploit their potential in every field of science including medical science specially in diagnosis. The variability they have in terms of their architecture, multiple layer learning, learning algorithms. So, the mathematical model can be applied with artificial intelligence i.e say Neural Network for much better result for medical diagnosis. ANN model will serve its role in decision making. The main conclusion of the study was as follows: Neural network model develop in this case could mimic the performance of a mechanistic model describing complex physical processes in the network. Neural network model could be comprehensively trained using randomly derived data from the model.

REFERENCES

[1] Asadi, M. S., et al. (2011). *Optimal number of neurons for a two layer neural network model of a process.* SICE Annual Conference (SICE), 2011 Proceedings of

[2] I.A. Basheera , M. Hajmeerb (2000) ―Artificial neural networks: fundamentals, computing, design, and Application‖.

[3] Brey, T., (1996). "Artificial neural network versus multiple linear regression prediciting P/B ratios from empirical data."

[4] Martin T. Hagan, H. B. D., Mark Blade (1996). *Neural Network Design*. Massachusetts

[5] Liu, Y., (2007). *Optimizing number of hidden neurons in neural networks*. Artificial Intelligence and Applications

[6] Paulo J. Lisboa a, Azzam F.G. Taktak b "The use of artificial neural networks in decision support in cancer: A systematic review".

[7] Filippo Amato1, Alberto López1*, Eladia María Peña-Méndez2, Petr Vaňhara3, Aleš Hampl3, 4, Josef Havel1, 5, Artificial neural networks in medical diagnosis.

[8] Lucila Ohno-Machado March 1996 "*Connectionist Models of Survival"*

[9] www.webmd.com

[10] Dipti.itchhaporia,peter B.Snow, Robert. J. Almassy,William J. Oetgen "Artificial Neural Network : Current status in Cardiovascular medicine"

[11] Ruchi sehrawat (year)"Neural Network".