CRITERIA OF ARTIFICIAL NEURAL NETWORK IN RECONITION OF PATTERN AND IMAGE AND ITS INFORMATION PROCESSING METHODOLOGY

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ABSTRACT

An Artificial Neural Network (ANN) is a biological implementation of neuron. Neurons are information processing unit that is inspired by the way biological nervous systems, such as the brain, process information. The key element of this paradigm is the novel structure of the information processing system. In last few years neural network (NN) technique has been applied to a variety of real word problem. For example speech generation and recognition, vision and robotics, hand written character recognition, medical diagnostic and game playing. This paper is describes techniques of Artificial Neural Network (ANN) in pattern recognition and image recognition and also gives a methodology about information of Artificial Neural Network (ANN).

Keywords: Pattern Recognition, Image Recognition, Artificial Neural Network (ANN)

I. INTRODUCTION

Pattern recognition is the study of how machines can observe the environment, learn to distinguish patterns of interest from their background, and make sound and reasonable decisions about the categories of the patterns. In spite of almost 50 years of research, design of a general purpose machine pattern recognizer remains an elusive goal. The best pattern recognizers in most instances are humans, yet we do not understand how humans recognize patterns. [1] The main characteristics of neural networks are that they have the ability to learn complex nonlinear input-output relationships, use sequential training procedures, and adapt themselves to the data. The most commonly used family of neural networks for pattern classification tasks [2] is the feed-forward network, which includes multilayer perceptron and Radial-Basis Function (RBF) networks. Artificial neural networks (ANNs) provide a new suite of nonlinear algorithms for feature extraction (using hidden layers) and classification (e.g., multilayer perceptrons). In addition, existing feature extraction and classification algorithms can also be mapped on neural network architectures for efficient (hardware) implementation. Image pre-processing is the technique of enhancing data images prior to computational processing. Preprocessing is the first phase of document analysis. The purpose of preprocessing is to improve the quality of the image being processed. It makes the subsequent phases of image processing like recognition of characters easier. Image preprocessing methods use the considerable redundancy in images. This paper also shows that how the use of artificial neural network simplifies development of a character recognition application, while achieving highest quality of recognition and good performance one of the most classical applications of the Artificial Neural Network is the Character Recognition System. [4]

II. PATTERN RECOGNITION

The recognition problem here is being posed as a classification or categorization task, where the classes are either defined by the system designer (in supervised classification) or are learned based on the similarity of patterns (in unsupervised classification).These applications include data mining (identifying a "pattern", e.g., correlation, or an outlier in millions of multidimensional patterns), document classification (efficiently searching text documents), financial forecasting, organization and retrieval of multimedia databases, and biometrics. The most commonly used family of neural networks for pattern classification tasks [2] is the feed-forward network, which includes multilayer perceptron and Radial-Basis Function (RBF) networks. Another popular network is the Self-Organizing Map (SOM), or Kohonen-Network [3], which is mainly used for data clustering and feature mapping. The learning process involves updating network architecture and connection weights so that a network can efficiently perform a specific classification/clustering task. The increasing popularity of neural network models to solve pattern recognition problems has been primarily due to their seemingly low dependence on domain-specific knowledge and due to the availability of efficient learning algorithms for practitioners to use. Interactive Voice Response (IVR) with pattern recognition based on Neural Networks was proposed by Syed Ayaz Ali Shah, Azzam ul Asar and S.F. Shaukat [5] for the first time in 2009. In this case, after entering the correct password the user is asked to input his voice sample which is used to verify his identity. The addition of voice pattern recognition in the authentication process can potentially further enhance the security level. The developed system is fully compliant with landline phone system. The results are promising based on false accept and false reject criteria offering quick response time. It can potentially play an effective role in the existing authentication techniques used for identity verification to access secured services through telephone or similar media. Over here speaker specific features are extracted using Mel Frequency Cepstral Coefficient (MFCC) while Multi Layer Perceptron (MLP) is used for feature matching. Our model is based on 8 kHz, 8 bit format using Pulse Code Modulation (PCM). At highest level, all speaker recognition systems contain two modules: Feature Extraction and Feature Matching. Similarly they operate in two modes: Training and Recognition/Testing modes. Both training and recognition modes include Feature Extraction and Feature Matching. In training mode speaker models are created for database. In this mode, useful features from speech signal are extracted and model is trained. The objective of the model is generalization of the speaker's voice beyond the training material so that any unknown speech signal can be classified as intended speaker or imposter. Inrecognition mode, system makes decision about the unknown speaker's identity claim. In this mode features are extracted from the speech signal of the unknown speaker using the same technique as in the training mode. Finally decision is made based on the similarity score. For speaker verification, the decision is either accepted or rejected for the identity claim. Two types of errors occur in speaker verification system- False Reject (FR) and False Accept (FA). When a true speaker is rejected by the speaker recognition system, it is called FR. Similarly FA occurs when imposter is recognized as a true speaker. Neural networks learn complex mappings between inputs and outputs and are particularly useful when the underlying statistics of the considered tasks are not well understood. Neural Networks being relatively new approach is investigated in this proposed solution. In this technique, a feed forward back propagation network is used for classification of speakers. The network is trained with the training sets extracted from the input speech by using MFCC technique of feature extraction. The model developed is a text-independent speaker verification system which can identify only a specific speaker based on his voice and rejects the claim of any other speaker.[5] Multilayer Perceptron (MLP)

having four layers comprising of one input layer, two hidden layers and one output layer has been used. The input layer has nineteen (19) neurons (as there are nineteen feature vectors from MFCC processor) and uses linear transfer function. The output layer has one neuron (as binary decision is to be made) and uses linear transfer function. It is trained using back propagation algorithm. The network is trained by using a built in train function .This function trains the network on training data (Supervised Learning). A three-layer feed forward neural network is typically composed of one input layer, one output layer and one hidden layers. In the input layer, each neuron corresponds to a feature; while in the output layer, each neuron corresponds to a predefined pattern. The best situation is that once a certain sample is input into the network, the output will be a vector with all elements as zero only except the one corresponding to the pattern that the sample belongs to.

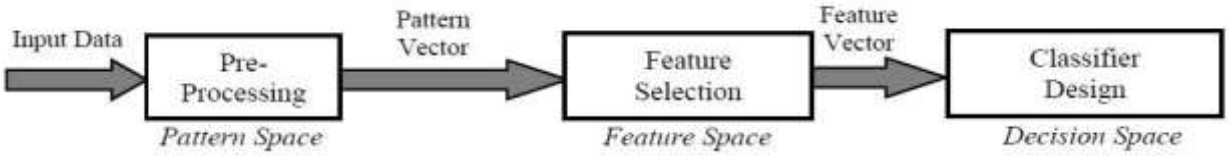

Fig 1:- Block Diagram of Pattern Recognition System

III. IMAGE RECOGNITION

This section will explain the proposed algorithm, i.e. what are different steps involve achieving in Image Preprocessing on Character Recognition Using Neural Network. In first step optical scanners are used, which generally consist of a transport mechanism plus a sensing device that converts light intensity into gray levels, through the scanning process a digital image of the original document is captured.

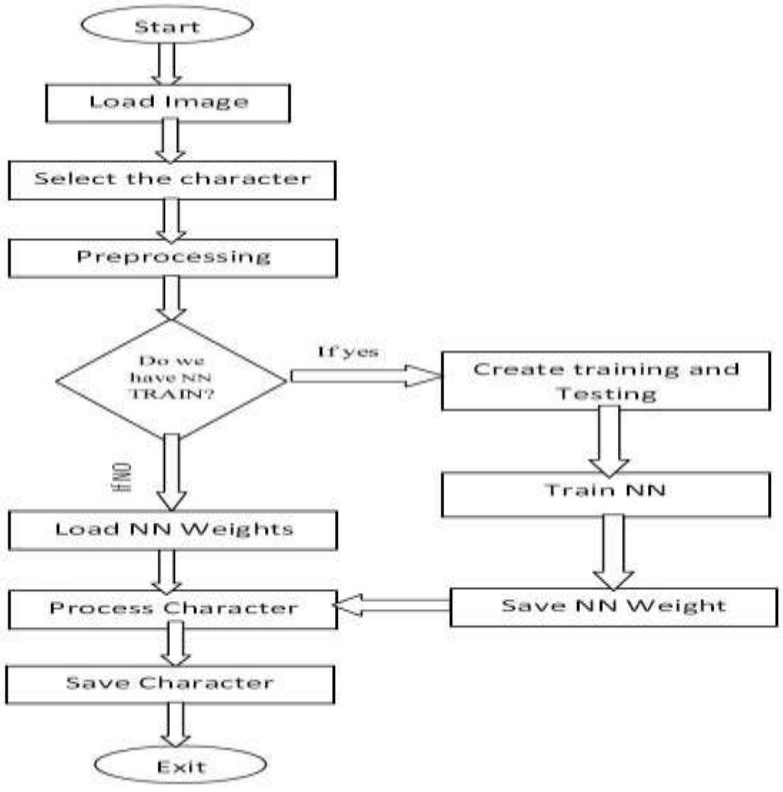

Fig 2:- Image Recognition Flowchart

The image resulting from the scanning process may contain a certain amount of noise due to defected medium or by others. In the second step describe implementation of preprocessing technique by loading the image. The

algorithm requires three major steps that define the system working theory and reason to behind their implementation.1) Image preprocessing 2) Neural network recognition 3) Back propagation Algorithm.[6]

3.1 Necr – Neural-Based Emotional Content Retrieval System

As we have mentioned above, the research investigates the feasibility of use of visual features for the retrieval of emotional content of images and tests feasibility of training ANN to accomplish classification task. To achieve this goal, a prototype system has been designed and implemented. In below system in order to test an influence of the visual feature descriptors on an ability to recognize the emotional content of images and to find similar images, we have considered three various groups of emotion classification:

• positive-negative with neutral option,

• groups of adjectives:

– warm, cold, neutral,

– dynamic, static, neutral,

– heavy, light, neutral,

– artificial, natural; to distinguish between photos and hand-made pictures,

• 5 basic emotions (happiness, sadness, anger, disgust and fear).[7]

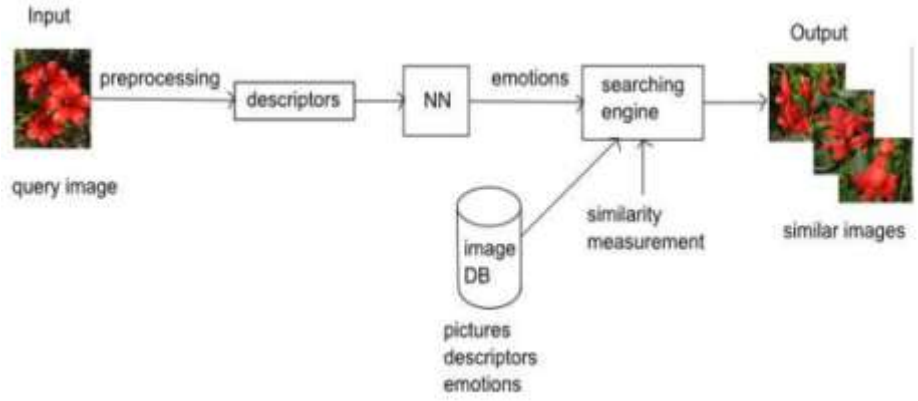

Fig 3:- Nuclear Based Emotional Contain Retrieval System

3.2 Back Propagation Algorithm in a Real Plane

Back propagation algorithm has been used extensively in neuron models. This algorithm is a development from the simple Delta rule in which extra hidden layers (layers additional to the input and output layers, not connected externally) are added. The network topology is constrained to be feed forward or loop-free - generally connections are allowed from the input layer to the first hidden layer; from the first hidden layer to the second and from the last hidden layer to the output layer. In a typical back propagation network, the hidden layer learns to recode (or to provide a representation for) the inputs. More than one hidden layer can be used. The architecture is more powerful than single-layer networks: it can be shown that any mapping can be learned, given two hidden layers (of units). The units are a little more complex than those in the original perceptron. Their input/ output graph is shown above. As a function:

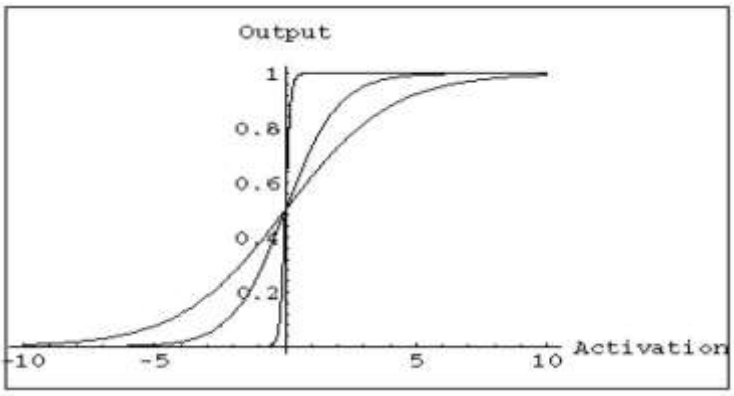

Fig 4:- Input/ Output Graph of a Back-Propagation Unit

$$Y=1 / (1 + e^{(-k.(\sum w \text{ in } * \text{ in}))})$$

The graph shows the output for *k=0.5, 1, and 10,* as the activation varies from -10 to 10.[8]

3.3 Methodology

The images were gathered to first train the neural network. Some of the images on which we trained our NN have been displayed above. Each image was read as a 2D array of pixel intensities for ORL database. Now the images read were converted to grayscale if they were in RGB format. Then masking was performed on the images. The grayscale images were masked off using a mast, an elliptical mask. This helped in extracting the oval face of a person and also removing the unnecessary background images.

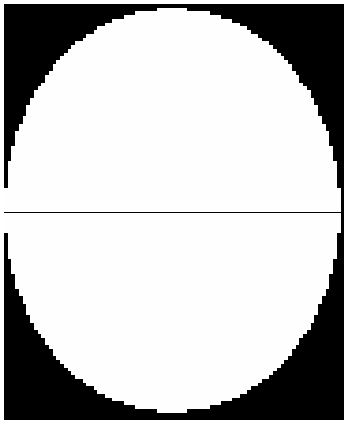

Fig 5:- Mask Used to Extract the Face

All these masked images were of resolution 92*112 so we resize them to 30*30 using the bilinear interpolation method with no filter. The resized images were then used to calculate the complex eigenvalues of the respective images. Thus the image of size 30*30 gives an array of eigenvalues of size 30. These 30 complex values are used as inputs to the complex Back propagation algorithm. The network uses complex weights and has 30 complex inputs and one output (complex). Then the network was trained for a given complex value for a given person.

3.4 Face Recognition System Using Image Processing and Neural Networks

Face recognition has become a very active area of research in recent years mainly due to increasing security demands and its potential commercial and law enforcement applications. with emphasis on such applications as human-computer interaction (HCI), biometric analysis, content-based coding of images and videos, and surveillance[9].

In their survey, they describe a preprocessing step that attempts to identify pixels associated with skin independently of facerelated features. This approach represents a dramatic reduction in computational requirements over previous methods.

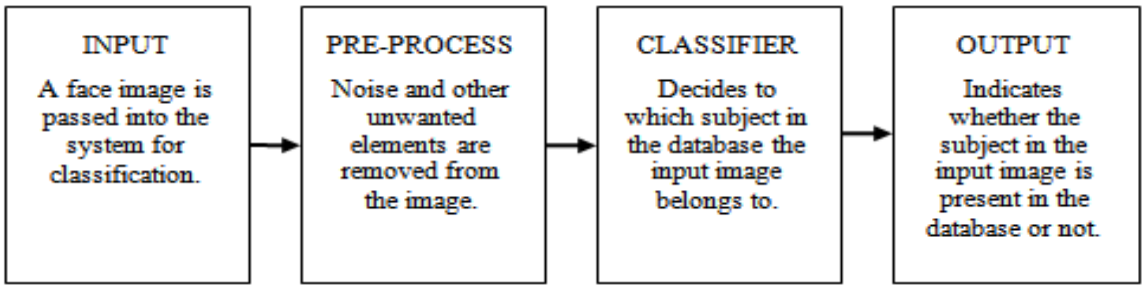

Fig 6:- Generic Representation of a Face Recognition System

The recognition stage typically uses an intensity (grayscale) representation of the image compressed by the 2D-DCT for further processing [9]. This grayscale version contains intensity values for skin pixels.

IV. INFORMATION PROCESSING METHODOLOGY IN AAN

The study of the human brain is thousands of years old. With the advent of modern electronics, it was only natural to try to harness this thinking process. The first step toward artificial neural networks came in 1943 when Warren McCulloch, a neurophysiologist, and a young mathematician, Walter Pitts, wrote a paper on how neurons might work. They modeled a simple neural network with electrical circuits. Neural networks, with their remarkable ability to derive meaning from complicated or imprecise data, can be used to extract patterns and detect trends that are too complex to be noticed by either humans or other computer techniques. A trained neural network can be thought of as an "expert" in the category of information it has been given to analyse. Other advantages include:

1. Adaptive learning: An ability to learn how to do tasks based on the data given for training or initial experience.
2. Self-Organisation: An ANN can create its own organisation or representation of the information it receives during learning time.
3. Real Time Operation: ANN computations may be carried out in parallel, and special hardware devices are being designed and manufactured which take advantage of this capability.
4. Fault Tolerance via Redundant Information Coding: Partial destruction of a network leads to the corresponding degradation of performance. However, some network capabilities may be retained even with major network damage. [10]

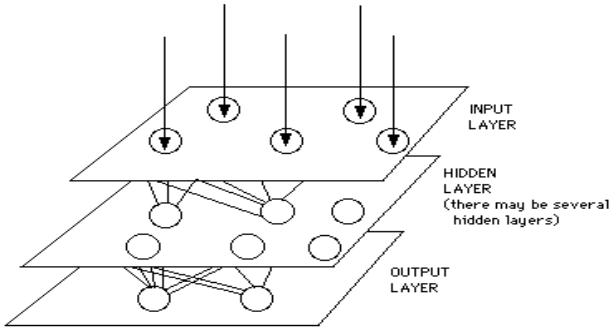

Fig 7:- A Simple Neural Network Diagram

Artificial neural networks have a similar structure or topology as shown in Figure1. In that structure some of the neurons interface to the real world to receive its inputs. Other neurons provide the real world with the network's outputs. This output might be the particular character that the network thinks that it has scanned or the particular image it thinks is being viewed. All the rest of the neurons are hidden from view.

Another type of connection is feedback. This is where the output of one layer routes back to a previous layer. An example of this is shown in Figure 8.

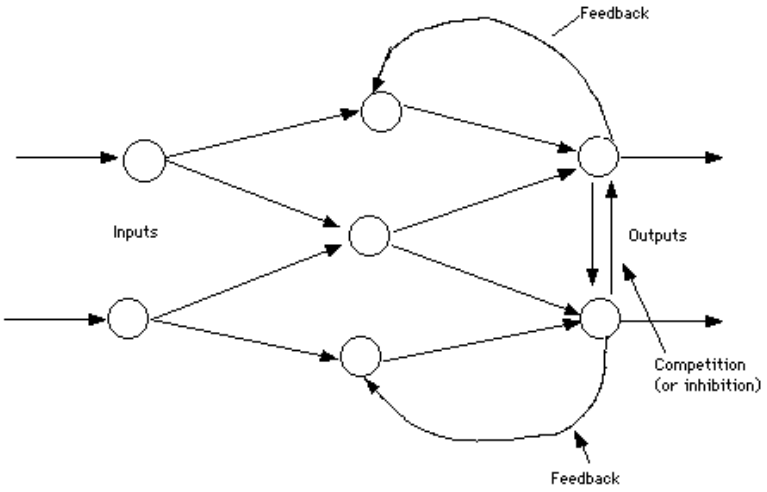

Fig 8:- Simple Network with Feedback and Competition.

4.1Biological Model of Neural Network

The brain and nervous system are enormously complex. The brain itself is composed of billions of nerve cells. The orchestration of all of these cells to allow people to sing, dance, write, talk, and think. Neuroscientist [11] calls the brain the *great integrator*. The brain does a wonderful job of pulling information together. The brain integrates all functions of the world including sounds, sights, touch, taste, genes and environment. Neurons are the nerve cells that actually handle the information processing function. The human brain contains about 100 billion neurons. The

average neuron is as complex as a small computer and has as many as 10,000 physical connections with other cells.

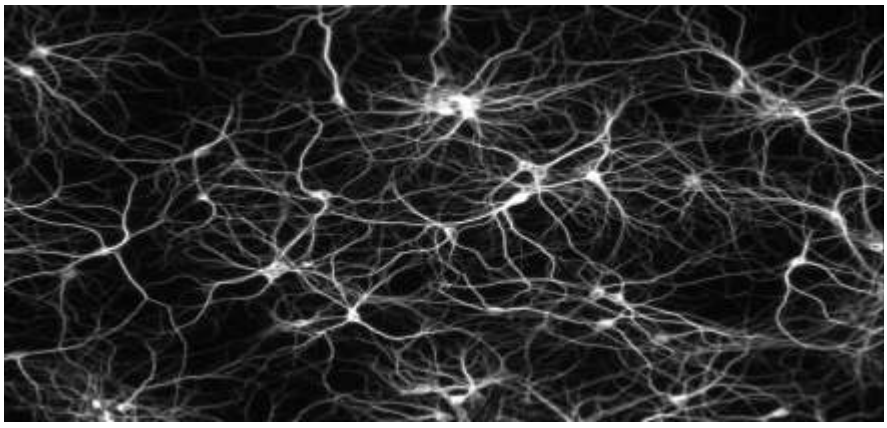

Fig 9:- Neural Network in Human Body

A neuron is a special biological cell that process information from one neuron to another neuron with the help of some electrical and chemical change. It is composed of a cell body or soma and two types of out reaching tree

like branches: the axon and the dendrites. The cell body has a nucleus that contains information about hereditary traits and plasma that holds the molecular equipments or producing material needed by the neurons *[12]*. The whole process of receiving and sending signals is done in particular manner like a neuron receives signals from other neuron through dendrites. The Neuron send signals at spikes of electrical activity through a long thin stand known as an axon and an axon splits this signals through synapse and send it to the other neurons *[13]*.

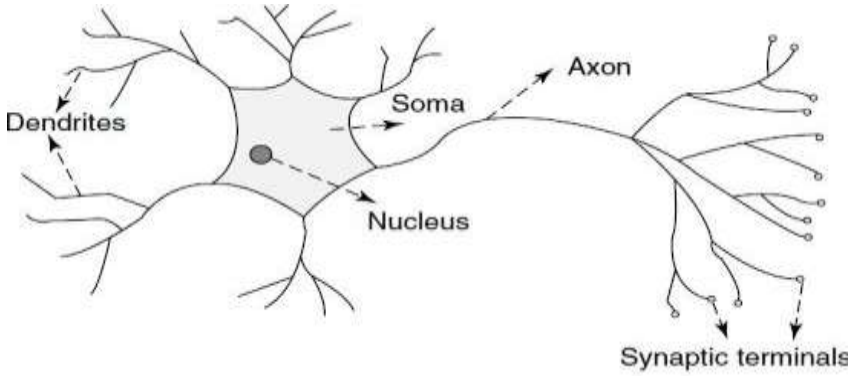

Fig 10:- Biological Model of Neuron.

V. CONCLUSION

The computing world has a lot to gain or benefits from neural networks approaches. Their ability to learn by example makes them very flexible and powerful. An approach has been made to increase the accuracy of recognition of handwritten scanned character. The neural networks can be used for image preprocessing pretty well with many advantages over normal image preprocessing methods. At last in this paper biological model of neuron is gives working principle of ANN (Artificial Neural Network).

VI. ACKNOWLEDGMENT

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