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A Review study on Kohonen Neural Network Structure and Applications

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Abstract— *This paper deals with the Kohonen Self-organizing network, structure of Kohonen network, Applications of Kohonen Neural Network. This paper describes feature extraction of image using Kohonen neural network*

Keywords— *AFR, SOM ,ANFIS ,CR ,NUM*

I. INTRODUCTION

Biometric face recognition, otherwise known as Automatic Face Recognition (AFR), is a particularly attractive biometric approach, since it focuses on the same identifier that humans use primarily to distinguish one person from another: their "faces". One of its main goals is the understanding of the complex human visual system and the knowledge of how humans represent faces in order to discriminate different identities with high accuracy. The face recognition problem can be divided into two main stages: face verification (or authentication), and face identification (or recognition). Biometrics is the emerging area of bioengineering; it is the automated method of recognizing person based on a physiological or behavioral characteristic. There exist several biometric systems such as signature, finger prints, voice, iris, retina, hand geometry, ear geometry, and face

II. KOHONEN NETWORK

Kohonen Self-Organizing Maps (or just Self-Organizing Maps, or SOMs for short), are a type of neural network. They were developed in 1982 by Tuevo Kohonen, a professor emeritus of the Academy of Finland. Self-Organizing Maps are aptly named. "Self-Organizing" is because no supervision is required. SOMs learn on their own through unsupervised competitive learning. "Maps" is because they attempt to map their weights to conform to the given input data. The nodes in a SOM network attempt to become like the inputs presented to them. In this sense, this is how they learn. They can also be called "Feature Maps", as in Self-Organizing Feature Maps. Retaining principle 'features' of the input data is a fundamental principle of SOMs, and one of the things that makes them so valuable. Specifically, the topological relationships between input data are preserved when mapped to a SOM network. This has a pragmatic value of representing complex data.

The self-organizing map also known as a Kohonen Map is a well-known artificial neural network. It is an unsupervised learning process, which learns the distribution of a set of patterns without any class information. It has the property of topology preservation. There is a competition among the neurons to be activated or fired. The result is that only one neuron that wins the competition is fired and is called the "winner".

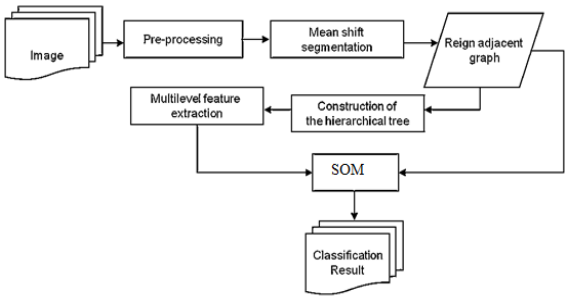

Figure 1: Feature Extraction

A Kohonen network identifies a winning neuron using the same procedure as employed by a competitive layer. However, instead of updating only the winning neuron, all neurons within a certain neighborhood of the winning neuron are updated using the Kohonen Rule. The Kohonen rule allows the weights of a neuron to learn an input vector, and because of this it is useful in recognition applications. A Kohonen is employed to classify DCT-based vectors into groups to identify if the subject in the input image is "present" or "not present" in the image database.

III. STRUCTURE OF KOHONEN NETWORK

The structure of a SOM is fairly simple, and is best understood with the use of an illustration such as

Figure 3.

It is easy to overlook this structure as being trivial, but there are a few key things to notice. First, each map node is connected to each input node. For this small 4x4 node network, that is 4x4x3=48 connections. Secondly, notice that map nodes are not connected to each other. The nodes are organized in this manner, as a 2-D grid makes it easy to visualize the results. This representation is also useful when the SOM algorithm is used. In this configuration, each map node has a unique (i,j) coordinate. This makes it easy to reference a node in the network, and to calculate the distances between nodes. Because of the connections only to the input nodes, the map nodes are oblivious as to what values their neighbors have.

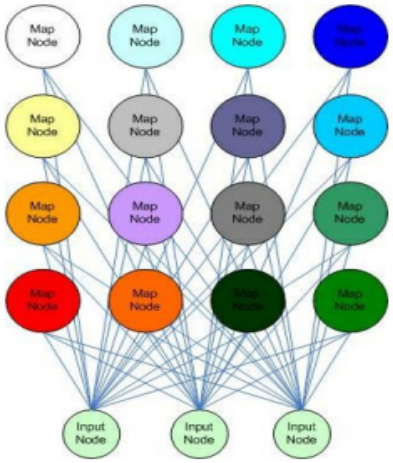

Figure 3 is a 4x4 SOM network (4 nodes down, 4 nodes across).

A map node will only update its' weights (explained next) based on what the input vector tells it.
The following relationships describe what a node essentially is: 1. network ⊂map Node⊂ float weights [num Weights]
2. input Vectors ⊂input Vector⊂ float weights[num Weights]
1 says that the network (the 4x4 grid above) contains map nodes. A single map node contains an array of floats, or its' weights. Num Weights will become more apparent during application discussion. The only other common item that a map node should contain is it's position in the network. 2 says that the collection of input vectors (or input nodes) contains individual input vectors. Each input vector contains an array of floats, or its' weights. Note that num Weights is the same for both weight vectors. The weight vectors must be the same for map nodes and input vectors or the algorithm will not work.
The first, Color Classification helps demonstrate the concept of SOMs. It is not very practical on its own. However, the framework presented can be used for other extremely pragmatic applications. One of these such useful applications is described in the second section, Image Classification. To go from the Color to Image Classification, all one needs to really change is the weight vector calculation, as the algorithms used are exactly the same.

IV. APPLICATION OF KOHONEN NETWORK

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V. LITERATURE REVIEW

Character Recognition (CR) is the electronic conversion of scanned images or camera captured images of hand written text into machine encoded text. In this project various image pre-processing, neural networks and classification algorithms have been discussed, to design high performance character reorganisation software for Indian Language Hindi based on Devanagari script. In this paper it is discussed that how to generate data for input of neural network, how it will work. This neural network is under development but as per my knowledge and previous record kohonen neural network with self organising map will surely give better result than other neural network. There will be increment in percentage of recognition rate compare to other neural network [1].

This report discusses the theory and implementation of an Optical Character Recognition (OCR) for Bangla. The principal idea is to convert images of text documents such as those obtained from scanning a document into editable texts. This report does not address the pre-processing steps such as skew correction and noise reduction (which is handled in a previous report), so the documents are assumed to pre-processed by another tool in the pipeline. For training and recognition, the input is then first converted to a binary image, and then into to a 25x25 pixel2 image; the only feature extracted from the images is a 625-bit long vector, which is then trained or classified using a Kohonen neural network. The OCR shows excellent performance for documents with single typeface. The work in progress is extending it to handle multiple typefaces [2].

This paper presents a simple learning rule for recognition of mouse dragged character on our computer screen using artificial neural network. We use Kohonen self-organization map for pattern classification which employs unsupervised learning algorithm. The results are quite encouraging in terms of percentage of characters being successfully recognized. One advantage of proposed scheme is that the system is quite tolerant to changing conditions and inputs. The system consistently learns. Moreover the recognition ratio is excellent in the proposed system [3].

Biometric recognition became an integral part of our living. This paper deals with machine learning methods for recognition of humans based on face and iris biometrics. The main intention of machine learning area is to reach a state when machines (computers) are able to respond without humans explicitly programming them. This area is closely related to artificial intelligence, knowledge discovery, data mining and neuro computing. We present relevant machine learning methods with main focus on neural networks. Some aspects of theory of neural networks are addressed such as visualization of processes in neural networks, internal representations of input data as a basis for new feature extraction methods and their applications to image compression and classification. Machine learning methods can be efficiently used for feature extraction and classification and therefore are directly applicable to biometric systems. Iris recognition is analyzed from the point of view of state-of-the art in iris recognition, 2D Gabor wavelets, use of convolution kernels and possibilities for the design of new kernels. Software and hardware implementations of face and iris recognition systems are discussed and an implementation of a multimodal interface (face and iris part of a system) is presented. Also a contribution of Machine Learning Group working at FEI SUT Bratislava to this research area is shown [4].

The image of a face varies with the illumination, pose, and facial expression, thus we say that a single face image is of high uncertainty for representing the face. However, in a real world face recognition system, a subject usually has only a limited number of available face images and thus there is high uncertainty. In this paper, we attempt to improve the face recognition accuracy by reducing the uncertainty. First, we reduce the uncertainty of the face representation by synthesizing the virtual training samples. Then, we select useful training samples that are similar to the test sample from the set of all the original and synthesized virtual training samples. Moreover, we state a theorem that determines the upper bound of the number of useful training samples. Finally, we devise a representation approach based on the selected useful training samples to perform face recognition. Experimental results on five widely used face databases demonstrate that our proposed approach can not only obtain a high face recognition accuracy, but also has a lower computational complexity than the other state-of-the-art approaches [5].

Face recognition is an emergent research area, spanning over multiple disciplines such as image processing, computer vision and signal processing. Moreover, face recognition is also used for identity authentication, security access control and intelligent human-computer interaction. This work compares face recognition methods using local features and global features. The local features were derived using Multi Scale Block Local Binary Patterns (MB-LBP) and global features are derived using Principal Component Analysis (PCA). For each facial image a spatially enhanced, concatenated representation was obtained by deriving a histogram from each grid of the divided input image. These histograms were projected to lower dimensions by applying PCA which represents local features to characterize the face of a subject. The global face representation of a subject was derived by projecting several images of the subject into lower dimensions applying PCA. Face Recognition was performed with different similarity metrics on ORL, JAFFE and INDIAN face databases and compared with other works. It was found that the local features (MB-LBP) are better than the global features (PCA) for face recognition [6].

Human-computer interaction system for an automatic face recognition or facial expression recognition has attracted increasing attention from researchers in psychology, computer science, linguistics, neuroscience, and related disciplines. In this paper, an Automatic Facial Expression Recognition System (AFERS) has been proposed. The proposed method has three stages: (a) face detection, (b) feature extraction and (c) facial expression recognition. The first phase of face detection involves skin color detection using YCbCr color model, lighting compensation for getting uniformity on face and morphological operations for retaining the required face portion. The output of the first phase is used for extracting facial features like eyes, nose, and mouth using AAM (Active Appearance Model) method. The third stage, automatic facial expression recognition, involves simple Euclidean Distance method. In this method, the Euclidean distance between the feature points of the training images and that of the query image is compared. Based on minimum Euclidean distance, output image expression is decided. True recognition rate for this method is around 90% -

95%. Further modification of this method is done using Artificial Neuro-Fuzzy Inference System (ANFIS). This non-linear recognition system gives recognition rate of around 100% which is acceptable compared to other methods [7].

VI. CONCLUSION

This paper has just begin to touch on the possibilities of Kohonen Neural Network. A type of neural network, Kohonen provide an elegant solution to many arduous problems with large or difficult to interpret data sets. Through their intrinsic properties, such as preserving topological relationships between input data, they allow the visualization of complex data. They are powerful enough to perform extremely computationally expensive operations such as image classification in a relatively short amount of time. Yet, they can be simple enough to code this in a relatively few number of lines, utilizing only a handful of equations.

VII. REFERENCES

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