Emerging Trends in Face Recognition Using Artificial Neural Networks

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Abstract— Neural networks are very popular image processing and data mining tool. Artificial neural networks are commonly known as neural networks. Neural networks are mainly used for face recognition system. Automatic recognition of faces is considered as a significant problem in the application of pattern recognition. This study discuss about recent and emerging trends of artificial neural networks.

Keywords — Artificial Neural Network, Face Recognition

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1. INTRODUCTION TO ARTIFICIAL NEURAL NETWORK

The term "artificial neural network" is derived from the concept of "neural network". According to Golden (1996), Neural Network is one of the data mining techniques. The neural networks are biological systems which have capacity to detect the patterns and make predictions and then learn it. The neural network is the machine learning technique and it was inspired by human brain. The neural networks can have capacity to perform complex tasks by interconnected neurons which can perform very simple operation. Neural network algorithm is considered as one of the powerful data modeling tools and it can able to analyze, capture and represent the complex input and output relationships. According to Guo and Li (2008), the neural network technology is derived from concept of artificial intelligent system which is similar to the human brains.

The artificial neural networks are the computer programs and applications that are implemented to provide machine learning algorithms and sophisticated pattern detection on the computer to build predictive models from the large and historical databases. According to Fine (1999), the concept of artificial neural network that is derived from the idea of historical development with the premise that the machines can "think" if the researcher identify the ways to mimic the function and structure of the human brain on computer. Artificial Neural Network is the artificial intelligence and it emerged with wide range of applications in data processing and pattern recognition. Artificial Neural Network (ANN) is considered as most popular system because of its self organizing, real time operations, fault tolerance and adaptive learning through the redundant information coding. The neural network models in the artificial intelligence are called artificial neural networks.

The following figure illustrates the function of artificial neural networks.

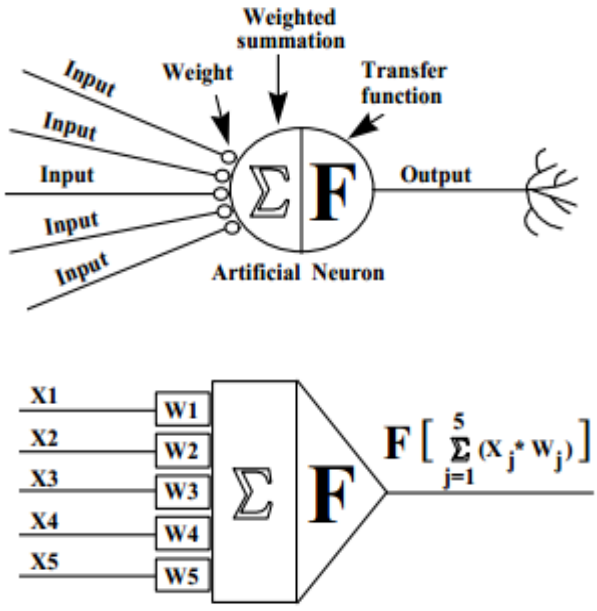

Figure 1: The Functions of an Artificial Neuron

Source: Li E Y (1994), Artificial Neural Networks and Their Business Applications, Information & Management 27(5), 303-313, 1994.

The artificial neural networks have neuron (processing element) which receives input from other elements and then weights are added to generate the result by transferring the function.

There are six main characteristics in artificial neural network technology:

- the network structures,
- the fault tolerance ability,
- the distributed memory,
- the learning ability,
- the collective solution and
- the parallel processing ability

2. GENERALIZED FEED FORWARD ARTIFICIAL NEURAL NETWORK

The feed forward neural network is also an artificial neural network and here, the connection between the units does not form any directed cycle and it is totally different from other recurrent neural networks. The feed forward neural network is a first simplest type of the artificial neural network. In feed forward neural network, the information or data moves only in one direction and it moves forward from input nodes to output nodes. Here, there are no loops or cycles in the network.

Back propagation algorithm is the multi-layer feed forward neural network and it is a supervised learning network which is based on the gradient descent learning rule. The multi-layer feed forward neural network refers to the network that may contain a set of source nodes (sensory units) that establish the output layer of computation nodes and one or more hidden layers with computation nodes and the input layer. Here, the input signal will pass through the network and also in forward direction from left to right and also on the layer-by-layer basis.

Face Recognition is a biometric tool for verification and identification of a person and it has gained a practical vitality and momentum in the wake of growing and increased security concerns. Face recognition is becoming very important and due to wide range of commercial and law enforcement applications which include border surveillance, access control, security systems, forensic identification, image and film processing and human computer interactions. According to Baker and Matthews (2001), face recognition system is one of the computer visions that automatically identify the human face from the database images. A face verification and facial recognition system is considered as a computer application for automatically verifying and identifying a person in the digital image. Innovative and varied face recognition systems are being developed with widely accepted algorithms.

GFFANN (Generalized Feed Forward Artificial Neural Network) is innovative feature extraction method for local face recognition. The segments of face such as mouth, eyes and nose bear significant information about person's facial identity. Generalized Feed Forward Artificial Neural Network provides the recognition rate nearly about 95%. Generalized Feed Forward Neural Network is mainly used for pattern regression and classification. The Generalized Feed Forward Neural Network architecture uses GSN (Generalized Shunting Neuron) model for basic computing unit. Generalized Feed Forward Neural Networks are capable for forming nonlinear and complex decision boundaries. The Generalized Feed Forward Artificial Neural Network will produce better results than the feed forward neural network.

3. FACE RECOGNITION USING ARTIFICIAL NEURAL NETWORK GAT (GROUP-BASED ADAPTIVE TOLERANCE) TREES

Artificial neural network research are focused towards on various simple models and also such simple models are not successful in producing results in complex systems like face recognition. One of the recent trends in face recognition using artificial neural network is artificial neural network group-based adaptive tolerance tree model. This model is translation invariant face recognition and it is suitable for airport security system. Artificial neural network group-based adaptive tolerance trees use the approach called two stage and divide and conquer tree type. In this approach, the first stage determines about the general properties of input (identifies about whether the given facial image contains any glasses or beard). Then the second stage of this approach identifies the individual.

According to Bernd (1997), there are two distinct techniques which may be applied into the recognition of digital images. The first technique is about matching template from the database which contains images. The second technique is about computation of set of features from the picture of face. The matching template is represented as the two-dimensional intensity value and it is compared using the suitable metric. There are different and complex approaches to use the single template together with face transformation's qualitative prior model from different viewpoints. Bounelli (1993) described that, this technique is popularly called as the template matching.

This technique is time consuming and cumbersome and not at all robust.

According to Wiskott (1997), a bunch graph method can be used to find the geometric features of the face. The following figure illustrates the face recognition system by using a group based adaptive neural network.

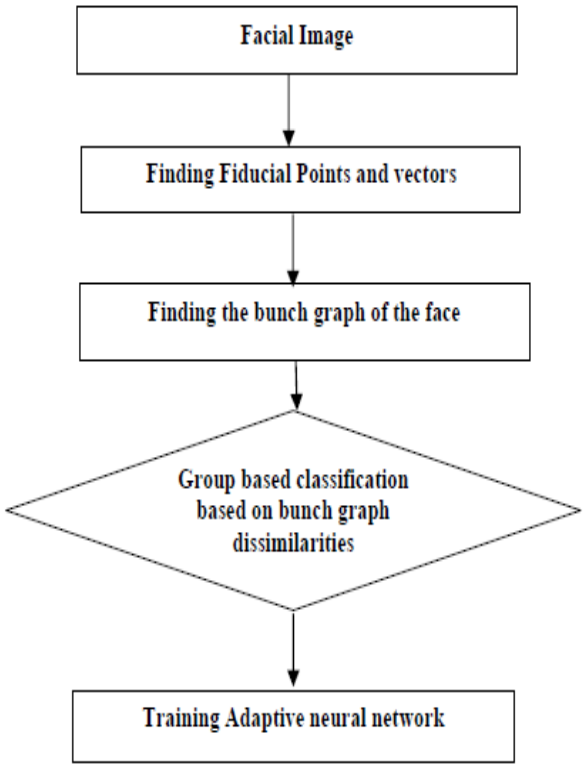

Figure 2: Face Recognition System by using a Group Based Adaptive Neural Network

Source: Aradhana D, Girish H, Karibasappa K (2011): British Journal of Mathematics & Computer Science 1(4): 194-203, 2011

Group based adaptive neural network first detects the face by the frame grabber. Then the fiducial points are manually selected and then vectors are estimated by joining the fiducial points with the available software. According to Chaddah (1996), after getting the fiducial vectors, the invariable facial images should be grouped under a specific class and it is trained by the adaptive neural network.

(A) FEATURE EXTRACTION BY BUNCH GRAPH METHOD

A bunch graph G represents the face which contains 'n' nodes and connected by E edges. All the nodes are located in the facial land marks x_n, where, $n = 1, 2, \ldots . N$ and it is called as Fiducial points that is the corner of mouth, bottom of the nose and tip of the nose, bottom and top of the ears, corner of the mouth, etc. The edges are assigned with two dimensional distant vectors $\Delta X_e = X_n - X_m$, $e = 1,2, \ldots \ldots E$ and here, edge 'e' connects node m and n. To automatically extract the bunch graph for face with geometrical relationship, the intuitively selected geometric relationship is used to find out the positions that are relative to the node points.

The following figure illustrates the fiducial points of human facial image.

Figure 3: Fiducial points that points out eyes, eyebrows, nose, ear, mouth, chin.

Source: Aradhana D, Girish H, Karibasappa K (2011): British Journal of Mathematics & Computer Science 1(4): 194-203, 2011

Procedure for feature extraction by bunch graph method:

Begin (for i =face 1 to face n)
Take the facial image from the database (BMP image) as input
A facial image is converted into a intensity image
Pertinent fiducial points are selected from the facial image manually
Vectors joining the fiducial points are extracted and normalized
Normalized vectors are stored in the form of a graph
End

These joining vectors and fiducial points are used for grouped specific orientation class.

(B) GROUP BASED ADAPTIVE NEURAL NETWORK

Face recognition is difficult for rotation invariant and shift invariant faces. When the face is rotated or shifted, face recognition becomes more difficult. For this problem, face recognition technique called translation-invariant was developed (Shalkoff, 1997). Artificial neural network group-based node has ability to recognize rotated and shifted faces in tow dimensions. Taking decision for the complex patterns such as translation invariant face recognition is considered as the difficult process.

The following figure illustrates the face recognition system for rotation invariant facial images.

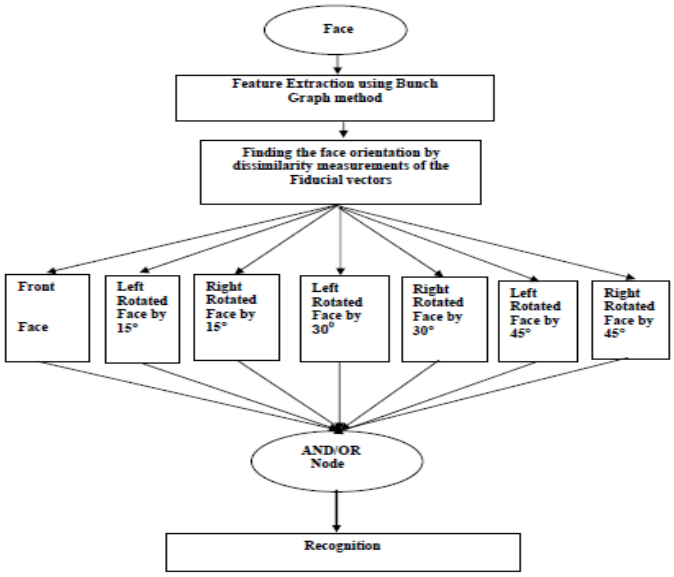

Figure 4: Face Recognition System for Rotation Invariant Facial Images

Source: Aradhana D, Girish H, Karibasappa K (2011): British Journal of Mathematics & Computer Science 1(4): 194-203, 2011

4. CONCLUSION

The field of artificial neural networks emerged from the period during 1970's and at that time single layer models were fundamentally proposed. In the early 1980's, multi-layer and trainable artificial neural networks were emerged into the industry. Artificial neural network have been increasingly popular from the days it came to the industry. Artificial neural networks are feasible for the business applications which require the results for complex system of recognizing patterns and images from imperfect inputs and to make decisions in changing environment. Recently, the uses of artificial neural network applications have been increasing in various industries. As per the trends, more and more development tools and developed applications have emerged on the market.

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