

A STUDY AND APPLICATION OF FACE RECOGNITION SYSTEM USING ARTIFICIAL NEURAL NETWORKS WITH BACK PROPAGATION

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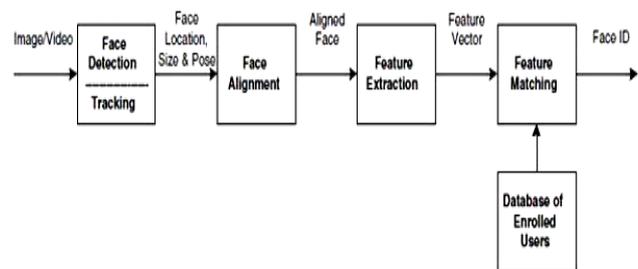
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Abstract: A face recognition system is a computer application for automatically identifying a person from a digital image or video frame from a video source. The problem in face recognition is to find the best match of an unknown image against a database of face models or to determine whether it does not match any of them well. In this method, back propagation neural network is integrates with the principal component analysis (PCA) and discrete cosine transform (DCT) to improve the performance of face recognition. Principal Component Analysis and the discrete cosine transform can be used for feature extraction and dimension reduction. Normalization can be used to eliminate the redundant information interference. The function of a neural network is to produce an output pattern when presented with an input pattern. The back propagation type of neural network is a feed forward system with training input pattern and weight adjustment with the associated error. The input neurons receive input signal and propagates into each hidden neuron, which again computes the activation to obtain the net output.

Key words: Face recognition, discrete cosine transform (DCT), Artificial neural network, Back propagation neural network (BPNN), principal component analysis (PCA)

I. INTRODUCTION

FACE document Face recognition is one of the most popular biometric modalities; it's a challenging field of research due to its wider range of application areas of today's life. Computational models of face recognition are interesting because they can contribute to theoretical knowledge as well as to practical application [1]. Now a days, the need to maintain the security of information or physical property is becoming more important because people are used to store their precious information in their mobile phones and if unfortunately their mobile phone will misplace or stolen then all their important information will be access by someone else and it also get misuse by others. The facial recognition process normally has four interrelated phases or steps. The first step is face detection, the second is normalization, the third is feature extraction, and the final cumulative step is face recognition. These steps depend on each other and often use similar techniques. The Face Recognition System has various applications like various authentication systems, security systems, Law enforcement and surveillance, entertainment, smart card etc. These applications are cost effective and consume less time.



Face recognition processing flow.

Fig1: Face recognition Processing steps

As the brain of human beings create the learning ability to recognize the persons by face even when the feature characteristics of the face changes. The neurons of the human brain are trained by reading or learning the face of a person and they can identify that face quickly even after several years. This ability of training and identifying is converted into machine systems using the Artificial Neural Networks. The basic function for the face recognition system is to compare the face of a person which is to be recognized with the faces already trained in the Artificial Neural Networks and it recognized the best matching face as output.

II. LITERATURE REVIEW

There are several methods for face recognition, the algorithm which integrates the principal component analysis; back propagation neural network (BPNN) and discrete cosine transform to improve the performance of face recognition. The recognition is done by the BPNN for efficient and robust face recognition, the global features extraction is completed using PCA based Eigen faces computation method and the detection part is completed using multi-layered feed forward Artificial Neural Networks with back propagation process [2], and its performance was evaluated. PCA with SOM is another algorithm better technique than 2D-DCT with SOM. It has discussed the face recognition method combined with PCA and the multi-layer network (BPNN) which is one of the intelligent classifications was suggested and its performance was evaluated [3]. Another recognition algorithm used is PCA (principal component analysis) using Eigen faces in which we recognize an unknown test image by comparing it with the known training images stored in the database as well as display information of the person detected. This algorithm gives different rates of accuracy under different conditions as experimentally observed [1]. In

that [4] given brief introduction about feature extraction using discrete cosine transform. DCT reduces the dimension of data to avoid singularity and decreases the computational cost of Principal component analysis. In this, various discrete cosine transform feature extraction approaches are considered and a new efficient approach is proposed.

III. PROPOSED WORK

In this paper it is proposed to study face recognition systems using neural network with the used of Back propagation algorithm and its application.

A. Principal Components Analysis (PCA)

It is a way to identifying patterns in data, and expressing the data in such a way as to highlight their similarities and differences. As it is very hard to find the data pattern in high dimension, therefore this methodology reduces the data without much losing its original information. It is a powerful tool for analyzing data. The other main advantage of PCA [7] is that as we get the patterns in data, and compress the data, i.e. by reducing the number of dimensions, without much loss of information. This technique used in image compression. PCA works on prediction, redundancy removal, feature extraction, data compression, etc. PCA is a classical technique works in linear domain, application having linear model are suitable such as image processing, system and control theory, communications, signal processing, etc. The major advantage of PCA is using it in Eigen faces approach which helps in reducing the size of the database for recognition of a test image. The images are stored as their feature vectors in the database which are found out projecting each and every trained image to the set of Eigenfaces obtained. PCA is applied on Eigenfaces approach to reduce the dimensionality of a large data set [2].



Fig.2 Examples of Eigen faces (PCA) [5]

B. Discrete Cosine Transform Overview

The discrete cosine transform is an algorithm widely used in different applications. The most popular use of the DCT is for data compression, as it forms the basis for the international standard loss image compression algorithm known as JPEG [8]. The DCT has the property that, for a typical image, most of the visually significant information about the image is concentrated in just a few coefficients. Extracted DCT coefficients can be used as a type of signature that is useful for recognition tasks, such as face recognition [9], [10]. Face images have high correlation and redundant information which causes computational burden in terms of

processing speed and memory utilization. The DCT transforms images from the spatial domain to the frequency domain. Since lower frequencies are more visually significant in an image than higher frequencies, the DCT discards high-frequency coefficients and quantizes the remaining coefficients. This reduces data volume without sacrificing too much image quality [3].

C. Artificial Neural Network

It is a computational system inspired by the formation, Processing Method, and Learning ability of a biological brain. There are a large number of different types of networks, but they all are characterized by the following mechanism: a set of nodes and connections between nodes. The nodes can be seen as computational units. They receive inputs, and process them to obtain an output. This processing might be very simple (such as summing the inputs), or quite complex (a node might contain another network...) the connections determine the information flow between nodes. They can be Unidirectional, when the information flows only in one sense and bidirectional, when the information flows in either sense.

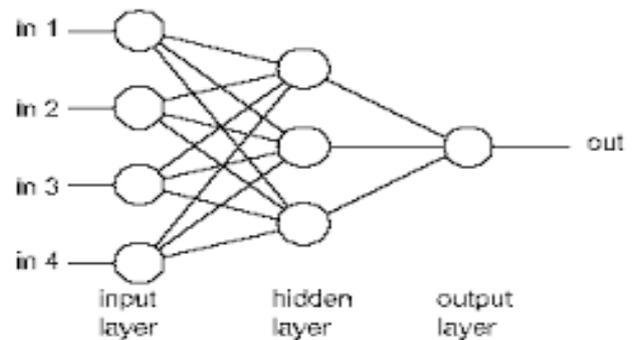


Fig.3: Architecture of Artificial neural network

D. Back propagation algorithm

As in the case with most neural networks, the aim is to train the network to achieve a balance between the network's ability to respond and the ability to give a reasonable response to the input that is similar, but not identical to the one used in the training. Back Propagation is a feed forward supervised learning network. Neural networks consist of the three layers as input layer, hidden layer and output layer as shown in Fig.4.

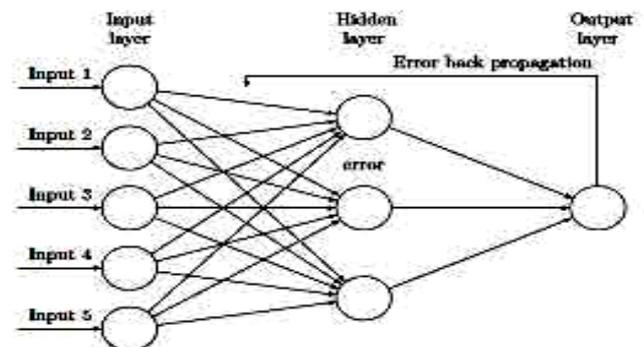


Fig.4 Back propagation neural network

These layers of elements make independent computation of data and pass it to another layer. The computation of processing elements is completed on the basis of weighted addition of the inputs. The output is compared with the target value and the mean square error is calculated which is processed back to the hidden layer to adjust its weights. This process is having iteration for each layer to minimize the error by repeatedly adjusting the weight of each layer. Hence, it is called the back propagation. The iteration process carried on until the error falls below the tolerance level [2].

The training of a back propagation network involves the two phases, propagation and weight adjustment [6].

Phase 1: Propagation

This propagation involves the following steps:

1. Forward propagation of a training pattern's input through the neural network in order to generate the propagation's output activations.
2. Backward propagation of the propagation's output activations through the neural network using the training pattern target in order to generate the deltas of all output and hidden neurons.

Phase 2: Weight update

For each weight-synapse follow the following steps:

1. Multiply its output delta and input activation to get the gradient of the weight.
2. Subtract a ratio (percentage) of the gradient from the weight.

After the network has been trained, its application involves only the feed forward phase. A multi layer network can learn only input patterns to an arbitrary accuracy. A weight in a neural network is a segment of the information about the input signal that has to be stored.

IV. APPLICATIONS & EXAMPLES

Face Identification: Face recognition systems establish the presence of an authorized person rather than just checking whether a valid identification (ID) or key is being used or whether the user knows the secret personal identification numbers (Pins) or passwords.

Security: Today more than ever, security is a primary concern at airports and for airline staff office and passengers. Airport protection systems that use face recognition technology have been implemented at many airports around the world. For example, In October, 2001, Fresno Yosemite International (FYI) airport in California deployed Viisage's face recognition technology for airport security purposes. The system is designed to alert FYI's airport public safety officers whenever an individual matching the appearance of a known terrorist suspect enters the airport's security checkpoint.

Surveillance: Like security applications in public places, surveillance by face recognition systems has a low user satisfaction level, if not lower. Example surveillance in Newham Borough of London, this has 300 cameras linked to the closed circuit TV (CCTV) controller room. The city council claims that the technology has helped to achieve a 34% drop in crime since its facility. Similar systems are in

place in Birmingham, England. In 1999 Visionics was awarded a contract from National Institute of Justice to develop smart CCTV technology [11].

V. CONCLUSION AND FUTURE WORK

Face recognition is a both challenging and important recognition technique. Among all the biometric techniques, face recognition approach possesses one great advantage, which is its user-friendliness. In this paper, we have given an introductory related literature review for the face recognition technology and we encourage the readers who are interested in this topic to go to the references for more detailed study.

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