Research Paper

FACE RECOGNITION SYSTEM USING BACK PROPAGATION ARTIFICIAL NEURAL NETWORKS

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ABSTRACT

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, we use back propagation neural network for implementation. It is an information processing system that has been developed as a generalization of the mathematical model of human recognition.

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. This face recognition system is implemented using a MATLAB software package. In this we used the neural networks tool box in matlab. We found the transformation for different inputs and compared with unknown face that the given face is in database or not.

KEYWORDS: Biometrics, Pixel, Image Processing, Segmentation, Neuron, Epoch

I. INTRODUCTION

Face recognition has been studied for many years and has practical application in areas such as security systems, identification of criminals and assistance with speech recognition system. Face Recognition is important to human because the face plays a major role in social intercourse, conveying emotions and feelings.

Humans are adept at recognizing faces and can do so with ease even under a range of difficult physical conditions. However, developing artificial systems to mimic the human ability has proven to be a very difficult and computationally complex task. There have been numerous studies exploiting various concepts and problems in the face recognition process and many steps in designing human face recognition system. Some of the systems have employed artificial neural networks while the others have a variety of approaches such as template matching of iso-density lines of subject faces. Comparison of sizes/relative distances of facial features (nose, eyes, mouth) of subjects of facial images. Figure 1 illustrates a generalized biometric identification system used in face recognition. Face recognition, although a trivial task for the human brain has proved to be extremely difficult to imitate artificially. It is commonly used in applications such as human-machine interfaces and automatic access control systems. Face recognition involves comparing an image with a database of stored faces in order to identify the individual in that input image. The related task of face detection has direct relevance to face recognition because images must be analyzed and faces identified, before they can be recognized. Detecting faces in an image can also help to focus the computational resources of the face recognition system, optimizing the systems speed and performance. Face detection involves separating image windows into two classes; one containing faces(targets),and one containing the background(clutter).It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color and facial expression.

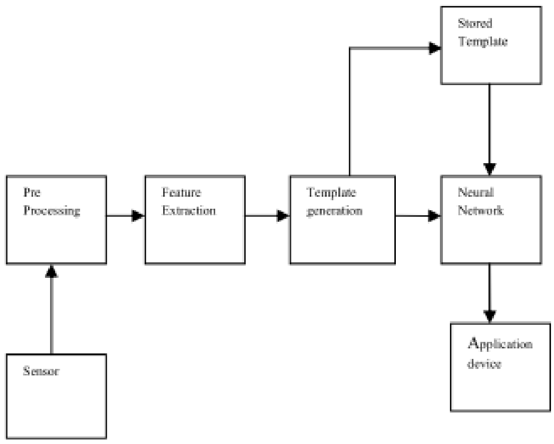

Figure 1: Face Recognition System

The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background. For basic pattern recognition systems, some of these effects can be avoided by assuming and ensuring a uniform background and fixed uniform lighting conditions. This assumption is acceptable for some applications, where lighting conditions can be controlled, and the image background will be uniform. For many applications however, this is unsuitable, and systems must be designed to accurately classify images subject to a variety of unpredictable conditions.

II. LITERATURE SURVEY

Hjelms and Low conducted a survey on face detection techniques, and identified two broad categories that separate the various approaches, appropriately named feature-based and image-based approaches. They divide the group of feature-based systems into three subcategories: low –level analysis, feature analysis and active shape models. Image-based approaches are divided into three sections: Linear subspace methods, neural networks and statistical approaches. Edge representation (detecting changes in pixel properties) was first implemented by

Sakai et al for detecting facial features in line drawings. In the face recognition research by Ching –Liang Su and Chidchanok Lursinsap the eyebrows, the eyes, nostrils, lips and face contour are extracted separately. The shape,size,object to object distances are found for each object. Zdravko Liposcak and Sven Loncaric presented a method for face recognition using profile images based on the representation of the original and morphological derived profile shapes. Here the information from profile outline that bounds the face and the hair is used. Face recognition using Multi-Resolution Transform deals with a technique for face recognition using Gabor wavelet transform. Gabor wavelet is used to extract the spatial frequency, spatial locality and orientation selectively from faces irrespective of the variations in the expression, illumination and pose. Simon Ceolin et al. have drawn ideas from the field of statistical shape analysis to construct shape spaces that span facial expressions and gender, and use the resulting shape model to perform face recognition under varying expression and gender. Pradeep Buddharaju et.al [7] say that some of the facial characteristics that are on the skin have low permanency and hence varies significantly with environmental factors. They presented a frame work for face recognition based on physiological information. The motivation behind this effort is to capitalize the permanency of characteristics that are under the skin. Here the algorithm delineates the human face from the back ground using the Bayesian framework. Then, it localizes the superficial blood vessel network produces contour shapes that are characteristics to each individual. Globally maximizing, locally minimizing. Unsupervised discriminant projection technique for dimensionality reduction of high dimensional data in small sample size cases. Rotation invariant multiview face detection is crucial as the first step in automatic face processing for general applications since face images are seldom upright and frontal unless they are taken cooperatively. This paper proposes a series of innovative methods to construct a high performance rotation invariant multiview face detector, including the width first search tree detector structure, the vector boosting algorithm, the domain partition based learning method, the sparse feature selection. In another paper by Federico M. Sukno *et al,* the problem of accurate segmentation of prominent features of the face in frontal view images is addressed. A method that generalizes linear active shape models is proposed. The techniques are built upon the development of a nonlinear intensity model, incorporating a reduced set of differential invariant features as local image descriptors.

III. METHODOLOGY

Face recognition process can be decomposed into two major tasks.

1. Finding a face in an image .

2. Recognizing or identification of that face.

Task 1: Finding a face in an image is also known as face registration or face localization.

- The control one has lighting and background conditions.
- Whether the image is color or monochrome and whether the images are still or video.

If the background lighting can be controlled then it might be possible to extract the head very simply as one of the main source of brightness in the image. Hence depending on the control, one has to cover these factors. Face recognition can be a hard or easy problem.

Task 2: Face recognition and verification

There are two versions of the face recognition problems. The recognition and the verification problem. In the face of the verification one has to test the likelihood. It involves testing the quality of match of an image against a single model. In the case of face recognition the problem is to find best match for an unknown image against a database of face models or to determine whether it does not match any of them well.

The practical importance of this distinction is the speed required. Generally if there are N subjects in the database then the recognition process will be N times slower than the verification process. This may place practical limits on the algorithm used. Although the ability to infer intelligence or character from facial appearance is suspect, the human ability to recognize face is remarkable. We can recognize thousands of faces learned throughout our lifetime and identify familiar faces at a glance even after years of separation. This skill is quite robust, despite large changes in the visual stimulus due to viewing conditions, expression, aging, and distractions such as glasses or changes in hairstyle or facial hair. As a consequence the visual processing of human faces has fascinated philosophers and scientists for centuries. Computational models of face recognition, in particular are interesting because they can contribute not only to theoretical insights but also to practical applications, Computers that recognize faces could be applied to a wide variety of problems, including criminal identification, security systems, image and film processing, and human-computer interaction. Detecting faces in photographs, for instance, is an important problem in automating color film development, since the effect of many enhancement and noise reduction techniques depends on the picture content (e.g., faces should not be tinted green, while perhaps grass should). Unfortunately, developing a computational model of face recognition developing is a quite difficult, because faces are complex, multidimensional, and meaningful visual stimuli. We therefore focused our research toward developing a sort of early, pre-attentive pattern recognition capability that does not depend on having three-dimensional information or detailed geometry. Our goal, which we believe we have reached, was to develop a computational model of face recognition that is fast, reasonably simple, and accurate in constrained environments such as an office or a household. In addition the approach is biologically implement able and is in concrete with preliminary findings in the physiology and psychology of face recognition.

The scheme is based on an information theory approach that decomposes face images into a small set of characteristics feature images called "eigen faces", which may be thought of as the principle components of the initial training set of face images. Recognition is performed by projecting a new image into the subspace spanned by the eigen faces ("face space") and then classifying the face by comparing its position in face space with the positions of known individuals.

Automatically learning and later recognizing new faces is practical within this framework. Recognition under widely varying conditions is achieved by training on a limited number of characteristics views (e.g., a "straight on" view, a 45⁰ view, and a profile view).

The approach has advantages over other face recognition schemes in its speed and simplicity, learning capacity, and insensitivity to small or gradual changes in the face image.

IV. NEURAL NETWORKS

How do you recognize a face in a crowd? When faced with problems like this the human brain uses a web of inter connected processing elements called neurons to process information. Each neuron is autonomous and independent. It does its work asynchronously i.e., without any synchronization to other even taking place. The two problems Pascal i.e., recognize a face and forecasting an interest rate have two important characteristics that distinguish them from other problem. The problem are complex i.e., you can't devise a simple step by step algorithm or precise formula to give you an answer. Resolve the problem is equally complex and may be noisy or incomplete.

A neural network is a computational structure inspired by the study of biological neural processing. There are many different types of neural networks from relatively simple to very complex just as there are many theories on how biological neural net work and branch out to other paradigm later. A layered feed forward neural network has layers of sub-groups of processing elements. A layer of processing elements makes independent computation or data that it receives and passes the result to another layer. The next layer may in turn make it independent computations and pass on the results to yet another layer. Finally a sub-group of one is more processing elements determine the output from the network. Each processing element makes its computation based upon a weighted sum of its inputs. The first layer is the input layer and the last is the output layer .

V. 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. The training of a back propagation network involves the three stages. The feed forward of the input training pattern, the calculation and the back propagation of the associated error and the weighted adjustment. 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.

VI . IMPLEMENTATION

Back propagation training takes place in 3 stages.

1. Feed forward of the input training pattern.
2. Back propagation of the associated error
3. Weight adjustment.

During feed forward, each input neuron receives an input a signal and broad casts it to the each hidden neuron, which in turn computes the activation and passes it on to its output unit, which again computes the activation to obtain the net output. During training, the net output is compared with the target value and the appropriate error is calculated, from the error, the error factorbk (delta K) is obtained which is used to distribute the error back to the hidden layer. The weights are updated accordingly. In a similar manner, the error factorb(delta j) is calculated for units Zi. After the error factors are obtained, the weights are updated simultaneously (Fig. 2).

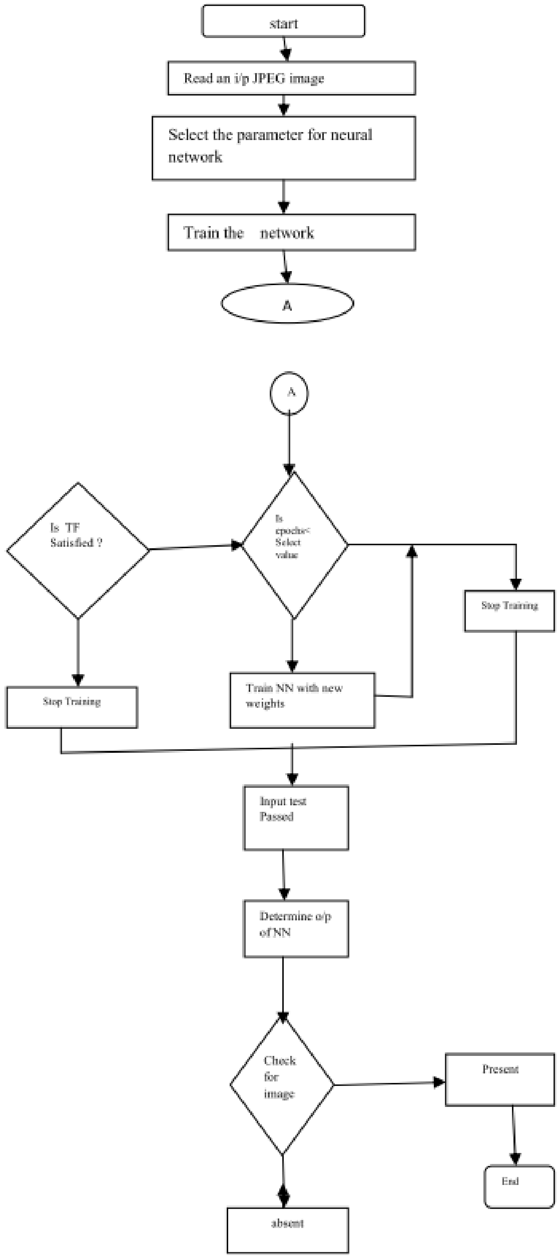

Figure 2: Flow Chart of Implementation

The Feed forward Back propagation network is a very popular model in neural network. It does not have feed back connections, but errors are back propagated during training. Least mean squared error is used. Many applications can be formulated for using a feed forward back propagation network and the methodology had ls been a model for most multi layer neural networks. Errors in the output determine measures of hidden layer output errors, which are used as a basis for adjustment for connection weights, forward the pairs of layer and recalculating the outputs is an iterative process i.e. carried on until the errors fall below a tolerance level. Learning rate parameters scale the adjustments from a previous iteration and adding to the adjustments in the current iteration.

The design flow of the feed forward back propagation network is as shown in figure .here, first we read the input image which is in the format jpeg, tiff,png etc. Then by selecting the parameters required for neural network ie, number of input layers, hidden layers and epochs, the network is trained. If the transfer function values of the input are similar to that of the transfer function values of known face, then the training is stopped. Otherwise increase the number of epochs. By comparing the values of the log-sigmoidal transfer function, the system decides whether the input is present or not.

VII. CONCLUSIONS

A Neural Network based face recognition system is proposed in this paper. This system performs human face recognition at a very high degree of accuracy. From our experiments, we found that the system is invariant to changes in background and illumination conditions. We encountered several problems in these experiments due to rigid motions and subject orientation. However, we were able to overcome the problem due to the subject orientation through neural network training.

Our results indicate that the conventional eigen face algorithm, which is essentially a minimum distance classifier, works well when lighting variation is small. Its performance deteriorates significantly as lighting variation increases. The reason for this deterioration is that lighting variation introduces biases in distance calculations. When such biases are large, the image distance is no longer a reliable measure. But the proposed system works well in spite of the lighting variations. The work can be readily used in biometric applications like access control and verification systems.

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