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Face Recognition with Radial Basis Function

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ABSTRACT: A generals and an efficient design approach using radial basis function(RBF) neural classifier to cope with small training sets of high dimension , which is a problem frequently encountered in face recognition, is presented in this paper. In order to avoid over fitting and reduce the computational burden, face features are first extracted by the discrete cosine transform method since Principal Component Analysis (PCA) approaches to face recognition are data dependent and computationally expensive. To classify unknown faces they need to match the nearest neighbor in the stored database of extracted face features. In this paper discrete Cosine Transforms(DCT) are used to reduce the dimensionality of face space by truncating high frequency DCT components. Then to avoid the undesired effects of dimensionality reduction techniques such as retaining illumination the resulting face features are further processed by Fisher's linear discriminant(FLD) technique to acquire lower dimensional dicriminant patterns. The main goal of dimension reduction is to concentrate on vital information while redundant information can be discarded. Various ways are developed to reduce dimensions. Reduction methods can be distinguished into linear and non-linear dimension reduction. In this thesis we shall present the application of face recognition with radial basis function neural networks using discrete cosine transform for featrure extraction and dimension reduction the system perform successfully with the diascrete cosine transform inspite of some problems the part of Fisher's linear discriminant criteria.

I.INTRODUCTION

Human beings are more intelligent than computers. Considering the calculation of sum of few hundred eight and nine digit numbers is a trivial calculation for a computer and its easy for a computer but when we come across the problem of solving the puzzles it is only human brain superior to computer in solving.

For vision or speech recognition the problem is a highly parallel one with many different and conflicting ideas and memory. Perhaps our brain's are able to operate in parallel easily and so we leave the computer far behind.

The conclusion that we can reach from all of this is that the problems which we are trying to solve are immensely parallel ones. The approach of neural computing is to capture the guiding principle that underlay the brain. tis problem and apply them to the computer system. In modeling the brains basic system we should end up with thw solution that it is intrinsically suited to the parallel problems rather than serial ones. These parallel models should be able to represent knowledge in a parallel fashion and process it in a similar way the ability to learn is not unique to the biological world ad it is captured within the neural network model. It takes some time for a machine for a good probalistic solution to a problem is the slow process of learning from experience continous until the probability of the machine making a good move for outweights the chance of it making a bad one this reinforcemet learning is analog to that which occur through the brain when te efficiencies of synaptic junction are increased in order to promote the recurrence of a neural event.

Brain is excellent at performing that we would like the computer to perform such as vision speech recognition by learning the examples and so on. Machine recognition of human fasces from still and video images has become an active research area in the image processing, pattern recognition, neural networks and computer vision. This interest is motivated by wide applications ranging from static matching of controlled format photograph such as passports, credit cards, driving licenses, and mugshots to real time matching of surveillance video images presenting different constraints in terms of processing requirements. Although researches in psychology, neural sciences and engineering, image processing and computer vision have been investigated a number of issues related to face recognition by human beings and machines. Iris still difficult to design an automatic system for this task, especially when real time identification is required.

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The lack of trust and public confidence in the security and privacy of electronic transaction seems to be among the most serious concerns, and is one of the main factors.

- Credit card fraud is becoming a major cause.
- The task of detecting and preventing fraudulent repudiation of web transactions is particularly challenging for mobile/wireless and smartcard platforms for a number of reasons.
- Mobile/wireless and smartcard platforms for a number of reasons.

PROBLEM FORMULATION

Facial recognition systems, one of the oldest forms of recognition, measure characteristics such as the distance between facial features or the dimensions of the features themselves. Most developers employ either neural network technology or statistical correlation's of the face's geometric shape. Many have had difficulty achieving high levels of performance when database sizes increase to the tens of thousands of more. The reasons for this difficulty are two-fold:

- Face images are highly variable and sources of variability include individual appearance, three dimensional.
- (3-D) pose, facial expression, facial hair, makeup and so on are the features changing from time to time. Furthermore the lighting, background, scale and parameters of the acquisition are all variables in facial images acquired under real world scenarios.

PROBLEM ANALYSIS

The problem of face recognition can be approached in three steps.

- Feature abstraction and representation
- Feature discrimination
- Feature classification and recognition

Many successful face detection and feature extraction paradigms have been developed, the frequently used approaches are to use geometrical features, where the relative positions and shapes of different features are measured. At the same time, several paradigms have been proposed to use global representation of a face, where all features of a face are automatically extracted from an input facial image. It has been indicated with the global encoding of a face are fast in face recognition. In SVD of a matrix was used to extract features from the patterns. It has been illustrated that singular values of an image are stable and represent the algebraic attributes of an image, being intrinsic but not necessarily to be visible, the eigen face approach of describing the features of a face was presented. The key idea is to calculate the best coordinate system for image compression, in which each coordinate is actually an image that is called an eigen picture. However, the principle component analysis yields projection directions that maximize the total scatter cross all classes i.e across all face images. In choosing the projection, maximizes the total scattering. PCA retains unwanted variations caused by lightning, face expression, all the other factors. Accordingly the features produced are not necessarily good for discrimination among classes. The face features are acquired by using the fisherface or discriminant eigenfeature paradigm. This paradigm aims at overcoming the drawback of the eigenface paradigm by integrating Fisher's linear discriminant criteria, while retaining the idea of the eigenface paradigm in projecting faces from a high definition image space to a significantly lower dimensional feature space. The goal of ace processing using neural networks is to develop a compact internal representation of faces, which is equivalent to feature extraction, therefore the number of hidden neurons is less than that in either input or output layers, which results in the network encoding inputs in a smaller dimension that retains most of the important information. Then the hidden units of the neural networks serve as the input layer of another neural network to classify face images.

The salient features of RBF neural networks are as follows:

- They are universal approximators.
- They possess the best approximation.
- Their learning speed is fast because of locally tuned neurons.
- They have more compact topology than other neural networks.

Normally RBF neural networks are widely used for function approximation and pattern recognition wherein the pattern dimensions in these application is usually small. When RBF neural networks are implemented in face recognition such

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systems possess the following characteristics with high dimensions. For example, a 128*128 image will have 16384 features.

Therefore, face recognition is substantially different from classical pattern recognition problem, for instance in which there are limited number of classes with the large number of training patterns in each class. This situation leads to the following challenges in designing an RBF neural classifier.

1)Overfitting problem:It has been indicated that if a dimension of the network input is comparable to the size of the training set, the syem is liable to RBF and result in poor generalization.
2)Overtraining problem:High dimension of the network input results in complex optimal processing and lw convergence. Hence it is likely to cause overtraining.
3)Small-sample effect: It has been indicated that small sample can be easily contaminate the design and evaluation of the proposed system. For application with a large number of features a complex classification rule training sample size must be quite large. I has been further pointed that the sample size needs to increase exponentially in order to have an effective estimate of multivariate densities as the dimension increases.
4)Singular problem: If n is less than r+1, the sample co variance matrix is singular, and therefore unusable regardless of the true value of the co variance matrix.

To circumvent the aforementioned problems, a systematic methodology for REF neural classifier design to deal with small training sets of high dimensional feature vectors is presented in this paper.
The proposed methodology comprises the following parts.

1. The number of input variables reduced through feature selection i.e, a set of the most expressive features is first generated by the PCA and the FLD is then implemented to generate a set of the most discriminant features so that different classes of training data can be separated as far as possible and the same classes of patterns are compacted as close as possible.
2. A new clustering algorithm concerning category information of training samples is proposed so that homogeneous data could be clustered and a compact structure of an REF neural classifier with limited mixed data could be achieved.

Two important criteria are proposed to estimate the initial widths of RBF units, which control the generalizations of RBF neural classifier.
The rest of the paper is organized as follows:

- A discrete cosine transform algorithm had been tried in the part of feature extraction in the existing system to improve the performance of the system.
- A number of Facial recognition systems have been developed with a various degree of success. The most common such system was based on the concept of Eigenface that is based on principle component analysis.

Principal Component Analysis approaches to face recognition are data dependent and computationally expensive. To classify unknown cases they need to match the nearest neighbour in the stores database of external face features. In this paper Discrete Cosine Transforms are used to reduce dimensionality of face space by truncating high frequency DCT components. The remaining coefficients are fed into a neural component.

1.Discrete Cosine Transform : The Discrete Cosine Transform transforms a signal from a spatial representation into a frequency representation. Generally lower frequencies contribute more to an image than higher frequencies. So if we transform an image into its frequency components using DCT and throw away a lot of data, called DCT coefficients, about higher frequencies we could reduce the amount of data needed to describe the image quality. This is called loss image compression and used widely with quite good performance in JPEG and MPEG. And this is what could play a role when we need to reduce the dimension of input space of a learning algorithm. The following are the formulas for a 2D DCT for NM size images, where F(u,v) is the DCT coefficient at point(u,v) for u=0,1,N1, v=0,1,M1 and f(x,y) is the original intensity at point (x,y) y V N xM y NM2 1 2 cos 2 1 2 0 1 0 where=otherwise for C, 1 0, 2 1 A 2D DCT ……… network for classification. Because a small number of coefficients are used, our DCT based approach to face recognition is extremely fast compared to other methods.

2.Dimensionality reduction: Discrete Cosine Transform is like the Fourier transform, uses a sinusoidal basis function. The difference is that the cosine transform basis functions are not complex since there are fast algorithms to compute

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2D DCT's and only a small number of coefficients are used, our DCT based approach to face recognition is extremely fast compared to other methods.

Eigen face approach is also used for extracting features that the aim is to calculate the best coordinate system for image compression. The drawback of the eigenface approach is that it retains unwanted information such as illumination facial expression and also because of this not only the recognition had become a problem the efficiency also has reduced to 50%.

It calculates the best coordinate for the iamge compression. These coordinated comprises the most expressive features similar to output from PCA .

II. PRINCIPAL COMPONENT ANALYSIS THEORY

Principal component Analysis is a standard technique commonly used for data reduction in statistical pattern recognition and signal processing. A common problem in statistical pattern recognition is that of feature selection or feature extraction. Feature selection refers to a process whereby a data space is transformed into feature space in theory has exactly the same dimension as original data space. The main aim of PCA is the dmensionality reduction.

Principal Component Analysis maximizes the rate of decrease of variance. We compute the eigen values and eigen vectors of correlation matrix of the input data vector and then project the date orthogonally onto the subspace spanned by eigen vectors belonging to the dominant eigen values the method of data representation is commonly referred to as subspace decomposition.

ALGORITHM

- Obtain the face images in integers.
- Convert it into a vector.
- Transpose it.
- Find the covariance matrix which is the product of vector and ts transpose.
- Find the eigen values and eigen vectors.
- Find the eigen vector by choosing the corresponding column of maximum eigen values.
- This eigenvector comprises of frequency components with less variance.
- Find the product of transpose of eigen vector and the image matrix.

RADIAL BASIS FUNCTION THEORY

In the radial basis function we prefer guassian type since it is factorizable. The width of the curve is large enough for optimal classification.

HIDDEN NODE SELECTION

- The type of RBF equation.
- The type of geometric features represented.
- The proposed learning scheme dor RBF.
- Set number of inputs=2.
- Initialize the protocols.
- Update the widths of the radial basis function.
- Initialize the weights of the network.
- Store the final weight.
- Repeat the loop equal to the number of inputs.

Thus the radial basis function provides an efficient learning algorithm and functions as a good classifier.

DISCRETE COSINE TRANSFORM

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DCT is a transform used in image compression for the calculation of the coordinate system for an image. It has been proved that it acts as a best compression for the variances. In the image and also it has the property of using in place of karhunenloeve transform.

III. A COMPARISON OF KL TRANSFORM AND DCT FEATURES OF KL TRANSFORM

The KL Transform is dependent on the statistics of data. The advantage in modeling the image autocorrelation by a separable function is that instead of solving n2*n2 matrix eigen value problem only two n*n matrix eigen value problems requires O(n3) computations the reduction in dimensionality is achieved by the separable model is O(n6)/O(N(3)=O/n which is very significant. The KL transform depends on the statistics as well as size of the image and transform matrix is computed is computed operation for performing the transformation are quite large for images.

IV. CONCLUSION

Face features are first extracted by the PCA paradigm so that the resulting data are compressed significantly. The information is further condensed via the FLD approach the data distribution training patterns based on our proposed approach is as in the detailed results.

1. Class overlapping gradually reduces as long as the decrease in the feature dimension but the clustering errors decrease for data from PCA & FLA methods.
2. from the data from PCA the clustering error increase along with decrease in the feature dimension but the clustering error decrease in feature dimension but the clustering errors decrease for data from PCA & FLD.
3. Data from PCA & FLD are still overlapping without complete separation unless the feature is less than 20 FLD idled alleviated the class overlapping.
4. The proposed system thus functioned effectively and efficiently with the discrete cosine transform and with the PCA.

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