



A NOVEL FACE RECOGNITION ALGORITHM USING GABOR - BASED KPCA

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Abstract

The Gabor wavelets are got used to something not going in a straight line mapping kernel PCA (DKPCA) is proposed to perform feature change and face apperception. The ordinary kernel PCA not going in a straight linearly maps an input image into a high-dimensional feature space in order to make the mapped features linearly capable of being separated. However, this method does not think about/believe the related to what holds something together and makes it strong features/ qualities/ traits of figure out which not going in a straight line mapping is more effective for face apperception. In this work, a starting to happen method of (not going in a straight line going in a straight line mapping not only thinks

about/believes the related to studying numbers properties with all/also adopts an Eigen mask to draw attention. The proposed set of computer instructions is figured out the worth, amount, or quality of based on the Yale computer file full of information, the AR computer file full of information, the ORL computer file full of information and the YaleB computer file full of information.

Index Terms: FER, KPCA, Gabor, DKPCA

1 INTRODUCTION

Human face apperception has engaged amazing and interesting attentions because of its long/big range of computer programs, such as criminal identification, credit card checking (for truth), security system, scene secretly recording/watching people, entertainments, etc. Among these applications, face apperception ways of doing things are related on assorted. In fact every communication systems followed a technique of this kind as it has the better decoding efficiency, even for algorithm very typical hardware is needed. The functioning obstructions will be eliminated when the decoding operation is in advance; it makes an improvement in designing Algorithm. This algorithm is beneficial in fast rate functions which could help decoding of codes at a very faster rate. Convolution codes are useful in gaining a possible code sequence. Face recognition algorithm uses maximum likelihood decoding process. Encoding or decoding is a process of modifying the message that can be understood easily. Decoding a message is the process of reconvertng the meaning of that message from codeword to words which can be easily understood. It has both verbal and non-verbal means of communication. Nonverbal decoding doesnt make use of words, but other gestures or signs. One can easily decode the human gestures based on their emotions.

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Most of the recognition techniques are based on statistical approach. And these techniques need more images of a person with different poses and different illumination conditions for better recognition accuracy. Practically it not possible. It needs to develop a face recognition system which requires only one image of a person for training of the system and can be implemented practically [3]. These captures salient visual properties such as spatial localization, orientation selectivity, and spatial frequency. That is using these kernels local features of face image are obtained. Since Gabor wave lets and PCA are used together, the recognition accuracy can be greatly improved.

2 BACKGROUND

Application of the Karhunen-Loeve (KL) extension for the presentation and basic cognitive process engendered. The KL extension has been designed or less thirty years its use in pattern basic cognitive process. Their applications have in addition been recorded for quite it slow. procedure involution was one in every of the explanations why KL ways [9], acquired, any image within the ensemble is just about reconstituted utilizing a weighted coalescence of Manfred Eigen footage KL transform [9].

The singular values (SV's) of an image are very secure and constitute the algebraic attributes of the image, being intrinsic

but not compulsorily visible [9]. It can be Proven their stability and invariance to proportional variance of image intensity in the optimal discriminate vector space, to transposition, rotation, translation, and reflection which are consequential properties of the SV feature vector [9].

Kernalized PCA method performs better generalization when the training set is non-linearly separable and by performing a non-linear mapping, the algorithm is found to be suitable for current approach as the technique works well with single face image per person. However in this dual port memory, One of the port is for writing the data and the second port is for reading the data, which is will be convenient for writing and reading the data simultaneously from various memory addresses. Memory must write the data in parallel while reading the data is asynchronous in order to maintain the lower latency or for better management of synchronous behavior in the entire system.

By using the Cover's theorem, nonlinearly separable patterns in an input space will get into linearly separable with an excessive probability if the input space is modified nonlinearly to a high-dimensional feature space. This plotting is usually achieved[7].

3 SYSTEM DESIGN

The formula for a posh Gabor perform in area domain is shown below

$$g(x,y)=s(x,y) w_r (x,y)$$

here $s(x, y)$ is complex sinusoid denoted as the carrier, and $w_r(x, y)$ is a 2 Dimensional Gaussian density function, called as the envelope.

The carrier or the complex sinusoid is given by
 $s(x,y)=\exp(j(2\Pi(u_0 x+v_0 y)+P))$

here (u_0, v_0) and P define the spatial frequency and the phase of the sinusoidal function. This sinusoid can be denoted with two separate real functions, conveniently allocated in the real and Imaginary part of a complex functions (shown in Figure 1) This algorithm is beneficial in fast rate functions which could help decoding of codes at a very faster rate. Convolution codes are useful in gaining a possible code sequence. Face recognition algorithm uses maximum likelihood decoding process. Encoding or decoding is a process of modifying the message that can be understood easily. Decoding a message is the process of reconvertng the meaning of that message from codeword to words which can be easily understood. It has both verbal and non-verbal means of communication. Nonverbal decoding doesn't make use of words, but other gestures or signs. One can easily decode the human gestures based on their emotions. Training is performed for face images of 12 persons. Here one face image is taken for each person. So training set size = 12. Following is the training set. Testing is performed with 96 images. Here each of above person's face images are given as input with different orientations. For each person, 9 face images are given as input.

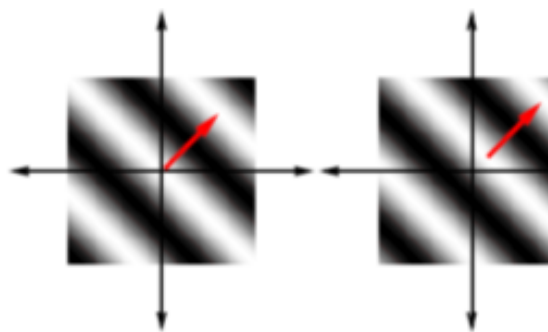


Figure 1. Complex sinusoid of real and imaginary parts

The size of the image is 128 128 pixels.

The parameters are: $u_0 = v_0 = 1/80$ cycles/pixel, $P = 0$ deg.

The real part and the imaginary part of this sinusoid are

$$\text{Re}(s(x,y)) = \cos(2\pi(u_0x + v_0y) + P)$$

$$\text{Im}(s(x,y)) = \sin(2\pi(u_0x + v_0y) + P)$$

The parameters u_0 and v_0 gives the space domain frequency of the sinusoidal in the Rectangular Coordinates. This Space Domain frequency can also be denoted in polar coordinates with magnitude F_0 and direction ω_0 : [6]

$$\begin{aligned} F_0 &= \sqrt{u_0^2 + v_0^2} \\ \omega_0 &= \tan^{-1}(v_0/u_0) \\ u_0 &= F_0 \cos \omega_0 \\ v_0 &= F_0 \sin \omega_0 \end{aligned}$$

Using this representation, the complex sinusoid is

$$s = \exp(j(2\pi F_0(x_0 \cos \omega_0 + y_0 \sin \omega_0) + P))$$

The complex Gabor function

The complex Gabor function is given depending on the following few parameters;

Parameter K Scales the magnitude of the Gaussian envelope and (a, b) parameters Scales the Gaussian envelop in two dimensions. At the same time the angle of the Gaussian envelope will be rotated by θ . The Rectangular pair (x_0, y_0) will determine the position of the peak value in the envelope. (u_0, v_0) indicate the Space Domain frequencies of the sinusoid carrier in rectangular or Cartesian coordinates the same is denoted as (F_0, ω_0) in polar system. Here P indicates to the Phase of the sinusoidal carrier signal.

$$\text{Polynomial Kernel : } k(Y_i, Y_j) = (Y_i, Y_j)^d$$

$$\text{Gaussian Kernel: } k(Y_i, Y_j) = \exp\left(-\frac{\|Y_i - Y_j\|^2}{2\sigma^2}\right)$$

$$\text{Sigmoid Kernel: } k(Y_i, Y_j) = \tan h(k(Y_i Y_j) + v)$$

Where $d > 0$, $k > 0$, and $v < 0$ the polynomial kernels are also extended for including fractional numbers. Using Power polynomial (FPP) models, i.e. $0 < d < 1$, a more reliable and efficient results can be achieved [6].

Pick an appropriate kernel function (the form of the kernel, plus any parameters). [3]

1. Construct the Kernel Matrix for the mapped data: [3]

$$K_{ij} \equiv \Phi(x_i)\Phi(x_j) = K(x_i, x_j)$$

2. Use this to construct the Covariance Matrix for the centered data: [3]

$$K_{ij} \equiv \Phi(x_i)\Phi(x_j) = K_{ij} - \frac{1}{N} \sum_{p=1}^N K_{ip} - \frac{1}{N} \sum_{q=1}^N K_{qj} + \frac{1}{N^2} \sum_{p,q=1}^N K_{pq}$$

3. Solve for the set of eigenvectors $\{b_i^\alpha : i=1 \text{ to } N, \alpha=1 \text{ to } M\}$ of the matrix K_i which give us our set of basis vectors $\{b_i^\alpha\}$ in feature space thus: [3]

$$\lambda^\alpha b_i^\alpha = \frac{1}{N} \sum_{j=1}^N K_{ij} b_j^\alpha, \lambda^\alpha > 0 \text{ where } b_i^\alpha \propto \Phi(x_i)$$

4. The unnormalised KPCA components of a test point x are then given by: [3]

$$p^\alpha(\bar{x}) \propto b_i^\alpha \cdot \Phi(\bar{x}) \propto \sum_{i=1}^N b_i^\alpha K(\bar{x}, \bar{x}_i)$$

4 RESULTS AND CONCLUSION

Training is performed for face images of 12 persons. Here one face image is taken for each person. So training set size = 12. Following is the training set. Testing is performed with 96 images. Here each of above person's face images are given as input with different orientations. For each person, 9 face images are given as input.



Figure 2. Training Set

Overall accuracy of system is around 89.58% (tested over 96 Images). Finally to test the superiority of the algorithm, images containing animals or any other are given as input. It is found that algorithm is able to discard those images. Following images are given as input (images containing non-human beings).

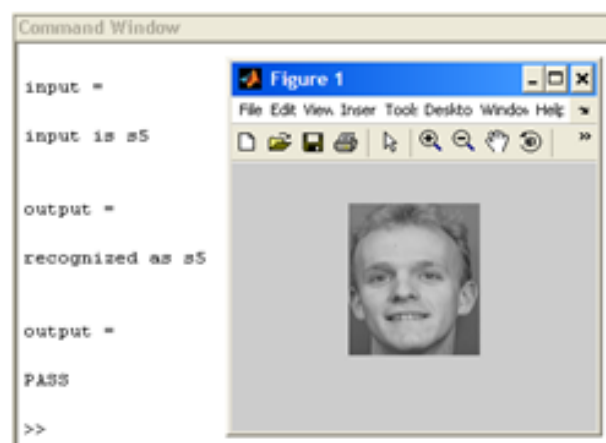


Figure 3. Detection of Eigen face (Pass Case)

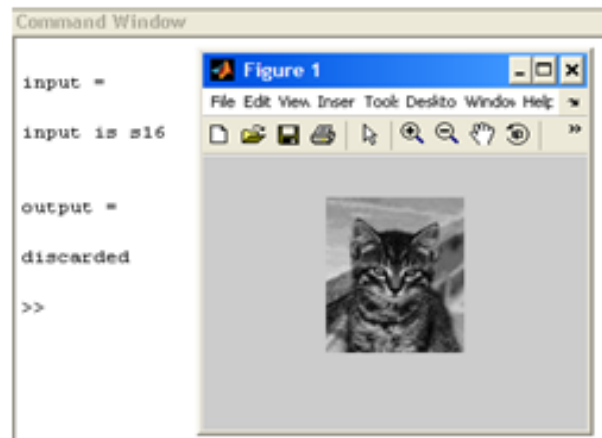


Figure 4. Tested output Mismatch Case

Also algorithm is expected to work for any other set of images by tweaking the model parameters. The accuracy in discarding images of nonhuman beings = 100% (tested with above a set of images)

5 CONCLUSION

This work utilized an algorithm which becomes more interesting and challenging for the researchers in the field of communications. It also has a broader range of applications in the digital communications field in this modern era of communications. This work helps in making use of efficient coding and decoding techniques with help of Viterbi algorithm. Also the algorithm can be easily understood and can be implemented easily. This work presents the implementation of the Viterbi algorithm using Verilog coding. Consequently, after the mappings, the transformed features have a higher discriminant puissance, and the consequentiality of the features habituates to the Space Domain consequentiality of the face image.

From the results I observe that Gabor based doubly nonlinear kernel PCA method is suited for face recognition and also works well even for different orientations of face, smiling face and

laughing face. Also the algorithm is able to discard when non-human being images are given as input to the system.

This approach for Face Recognition is faster and simpler method which gives promising results well below the environment of constrained data set. One of the limitations for this approach is the treatment of face images with glasses. Research needs to be done on this aspect. If drastic changes in poses the recognition accuracy decreases. It is more useful if the Face Recognition system is developed which is completely pose invariant.

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