Face Recognition for Border Security

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Abstract:- **Face recognition presents a challenging problem in the field of image analysis and computer vision.In this paper we will be seeing how facial recognition can be used for Border Security which identifies or authenticates individuals by comparing their face against a database of known faces.The process can be broken down into 3 general steps.First step is the computer finds the face in the image. Second step is a numeric representation of the face is created based on the relative position, size and shape of facial features. Third step is the numeric "map" of the face in the image is compared to database images of previously identified faces.**

General Terms: Computer Vision

Keywords:- Face Recognition,Principal Component Analysis

1. INTRODUCTION

The task of facial recognition is discriminating input signals (image data) into several classes (persons). The input signals are highly noisy (e.g. the noise is caused by differing lighting conditions, pose etc.), yet the input images are not completelyrandom and in spite of their differences there are patterns which occur in any input signal. Such patterns, which can be observed in all signals could be - in the domain of facial recognition - the presence of some objects (eyes, nose, mouth) in any face as well as relative distances between these objects. These characteristic features are called eigenfaces in the facial recognition domain (or principal components generally). They can be extracted out of original image data by means of a mathematical tool called Principal Component Analysis (PCA).

By means of PCA one can transform each original image of the training set into a corresponding eigenface. An important feature of PCA is that one can reconstruct any original image from the training set by combining the eigenfaces. Remember that eigenfaces are nothing less than characteristic features of the faces. Therefore one could say that the original face image can be reconstructed from eigenfaces if one adds up all the eigenfaces (features) in the right proportion. Each eigenface represents only certain features of the face, which may or may not be present in the original image. If the feature is present in the original image to a higher degree, the share of the corresponding eigenface in the "sum" of the eigenfaces should be greater. If, contrary, the particular feature is not (or almost not) present in the original image, then the corresponding eigenface should contribute a smaller (or not at all) part to the sum of eigenfaces. So, in order to reconstruct the original image from the eigenfaces, one has to build a kind of weighted sum of all eigenfaces. That is, the reconstructed original image is equal to a sum of all eigenfaces, with each eigenface having a certain weight. This weight specifies, to what degree the specific feature (eigenface) is present in the original image.

2. EIGENVECTORS AND EIGENVALUES

An eigenvector of a matrix is a vector such that, if multiplied with the matrix, the result is always an integer multiple of that vector. This integer value is the corresponding eigenvalue of the eigenvector. This relationship can be described by the equation M × u = × u, where u is an eigenvector of the matrix M and is the corresponding eigenvalue. Eigenvectors possess following properties:

- They can be determined only for square matrices
- There are n eigenvectors (and corresponding eigenvalues) in a n × n matrix.
- All eigenvectors are perpendicular, i.e. at right angle with each other.

3. SUMMARIZING THE PCA APPROACH

Listed below are the 6 general steps for performing a principal component analysis.

Take the whole dataset consisting of *d*

- dimensional samples ignoring the class labels
- Compute the *d*
- dimensional mean vector (i.e., the means for every dimension of the whole dataset)
- Compute the scatter matrix (alternatively, the covariance matrix) of the whole data set
- Compute eigenvectors (*ee*1,*ee*2,...,*eed*) and corresponding eigenvalues (*λλ*1,*λλ*2,...,*λλd*)
- Sort the eigenvectors by decreasing eigenvalues and choose *k* eigenvectors with the largest eigenvalues to form a *d*×*k* dimensional matrix *WW* (where every column represents an eigenvector)
- Use this *d*×*k* eigenvector matrix to transform the samples onto the new subspace. This can be summarized by the mathematical equation: *yy*=*WWT*×*x*

4. WHY USE IT FOR BORDER CONTROL?

- *Increases efficiency*
  Facial recognition technology allows border control agents to automate passport checks providing

immigration officials the opportunity to concentrate on other important activities such as eliminating terrorism threats at the border.

- *Passiveness*
  Due to its passive nature, facial recognition is often favoured over other forms of biometric identification such as fingerprinting for border control. Facial recognition devices used to take traveller images do not require any physical contact helping to increase acceptability among travellers.

5. CONCLUSION

Facial recognition can add a new dimension to border control security by making it easier to quickly and accurately identify travellers. Facial recognition has all the attributes of an end to end identity management system with the added advantage of convenience and speed. We will continue to see the expanded use of this technology, making our lives easier.

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