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E CRIME DETECTION Using FACE RECOGNITION SYSTEM

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ABSTRACT

Proposed system is going to identify criminals at various security place such as airport, railway etc. Video Camera captures a fixed number of frames of a person coming in front of check in counter. Proposed system compares these captured images taken through the camera with the images of the criminals which are stored in the database. Proposed system is connection of two stages – Face detection using Haar Based Cascade classifier and recognition using Principle Component analysis with Eigen Face. The goal is to implement the system
(model) for a particular face and distinguish it from a large number of stored faces with some real-time variations as well.

General Terms

Haar Based Cascade Classifier, Principal Component Analysis, Eigen Vector

Keywords

Object Detection, Verification, Real time tracking

1. BACKGROUND

Facial Recognition is a computer application composes for complex algorithms that use mathematical and matricial techniques, these get the image in raster model(digital format) and then process and compare pixel by pixel using different methods to obtain a faster and reliable results,obviously these results depends on the machine use to process this due to the huge computational poer that these algorithms,functions and routines requires, these are the most popular techniques used for solve the modern problems.

Some facial recognition algorithms identify faces by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face detection. A probe image is then compared with the face data. One of the earliest successful systems is based on template matching techniques applied to a set of salient facial features, providing a sort of compressed face representation. Recognition algorithms can be divided into two main approaches, geometric, which looks at distinguishing features, or photometric, which is a statistical approach that distill an image into values and comparing the values with templates to eliminate variances. Popular recognition algorithms include Principal Component Analysis with eigenface, Linear Discriminate Analysis, Elastic Bunch Graph Matching fisherface, the Hidden Markov model, and the neuronal motivated dynamic link matching.

2. INTRODUCTION

This paper is a step towards developing a real time face recognition system which can recognize static images and can be modified to work with dynamic images. In that case the

dynamic images received from the camera can first be converted in to the static ones and then the some procedure can be applied on them . This is to improve the face detection system by using Haar Classifier to get higher accuracy result. Haar Classifier is used for face detection because it can detect the desire image very fast. The main challenge for a face recognition system is of effective feature extraction. In this project we implementing the system to find the locations of Eigen features with maximal magnitudes at single scale and multiple orientations using sliding window - based search and then use the same feature locations for all other scales. For further feature compression we used Principal Component Analysis (PCA) because its simple implementation, fast training. The proposed system utilizes the Eigen face method is information reduction for the images. There is an incredible
amount of information present even in a small face image. Each face that we wish to classify can be projected into face-space and then analyzed as a vector. Euclidean distance measure can be used for classification.

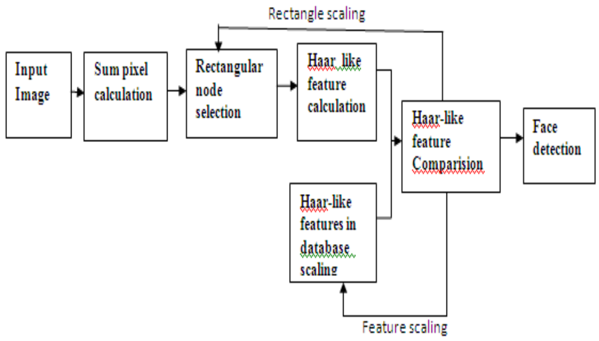
3. SYSTEM ARCHITECTURE

This section gives an overview of the major Face detection and recognition system.

3.1. Face detection using HAAR Cascade Classifiers

The function of this module is to determine where in an image a face is located. The face detection module works by scanning up an image at different scales and looking for some simple patterns that denote the presence of a appears in the centre and presented at a uniform size. Face detection determines where in an image a face is located. The face detection works by scanning up an image at different scales and looking for some simple patterns that identify the presence of a face.

The overall algorithm for the face detector is shown in figure



3.2. Face recognition using Principal Component Analysis with Eigen face

A **set of eigenfaces** can be generated by performing a mathematical process called principal component analysis (PCA) on a large set of images depicting different human faces.The main idea of using PCA for face recognition is to express the large 1-D vector of pixels constructed from 2-D facial image into the compact principal components of the feature space. This can be called Eigenspace projection. Eigenspace is calculated by identifying the eigenvectors of the
covariance matrix derived from a set of facial images(vectors). Informally, eigenfaces can be considered a set of "standardized face ingredients", derived from statistical analysis of many pictures of faces. Any human face can be considered to be a combination of these standard faces. For example, one's face might be composed of the average face plus 10% from eigenface 1. 55% from eigenface 2, and even -3% from eigenface 3. Remarkably, it does not take many eigenfaces combined together to achieve a fair approximation of most faces. Also, because a person's face is not recorded by a digital photograph, but instead as just a list of values (one value for

each eigenface in the database used), much less space is taken for each person's face.

Steps

A 2-D facial image can be represented as 1-D vector by concatenating each row (or column) into a long thin vector. Let's suppose we have *M* vectors o f size *N* (= rows of image *X* columns of image) representing a set of sampled images.

1. The first step is to obtain a set S with M face images. Each image is transformed into a vector of size N and placed into the set $S=\{r_1,r_2,r_3,\ldots,r_M\}$.

2. After you have obtained your set, you will obtain the mean image ψ

$$\psi=\frac{1}{M}\sum_{i=1}^{M} r_i$$

3. Then you will find the difference ϕ between the input image and the mean image

$$\phi_i=r_i-\psi \ (i=1,2,3,\ldots,M)$$

4. Next we seek a set of M orthonormal vectors u_k , which best describes the distribution of the data. The kth vector, u_k, is chosen such that

$$\lambda_k=\frac{1}{M}\sum_{n=1}^{M}(u^T_k\,\phi_n)^2$$

is a maximum, subject to

$$u_k=\delta_{lk}=1 \text{ if } l=k$$
$$\text{or } =0 \quad \text{otherwise}$$

Note: u_k and λ_k are the eigenvectors and eigenvalues of the covariance matrix C

5.Calculation of the covariance matrix. We obtain the covariance matrix C in the following manner

$$C=\frac{1}{M}\sum_{n=1}^{M}(\phi_1\phi_1^T),\phi=(\phi_1,\phi_2,\ldots,\phi_M)$$
$$C=AA^T,$$

Where A is a column-wise concatenation of all the ϕ_i's

$$A=(\phi_1,\phi_2,\ldots,\phi_M)$$

6. Calculation of the Eigenvectors and Eigen values .The size of C N*N is which could be enormous. For example, images of size 64*64 create the covariance matrix of size 4096*4096 . It is not practical to solve for the eigenvectors of C directly. A common theorem in linear algebra states that the vectors v_1 and scalars λ_1, can be obtained by solving for the eigenvectors and eigenvalues of the M X M matrix. To go through this problem[1] propose the following solution. For an eigenvector v_1 associated to an eigenvalue λ_1 we have:

$$Cv_i=\lambda_i v_i$$

The matrix C has the form AA^T . Let us consider the matrix

$L=AA^T$ having the Eigenvectors u_1 associated to Eigenvalues Θ_1 $L_1=\Theta_1 u_1$

Let AA^T $u_i=\Theta_i u_i$

By multiplying by A the left of the two sides of the equality,
we obtain:

$$AA^T Au_i= A\,\Theta_i u_i$$

And since $C=AA^T$ we can simplify (8):

$$C\,Au_1 = A\,\Theta_1 u_1$$
$$C\,(Au_i) = \Theta_i\,(Au_i)$$

According to the definition of the eigenvectors and Eigenvalues of the matrix C we have:

$$v_i= Au_i$$
$$\lambda_1=\Theta_1$$

Then comes the stage of selection of the eigenvectors and Eigenvalues where PCA selects only M' (M' < M) associated to the largest Eigenvalues (those associated to the smallest Eigen values contains only very little useful information). Find the M eigenvector, v1 of L.

7. These vectors (v_1) determine linear combinations of the M training set face images to form the eigenfaces u_1

$$u_l=\sum_{k=1}^{M} v_{lk}\,\phi_k \quad l=1,2,\ldots,M$$

8. Project each of the original images into Eigen space. This gives a vector of weights representing the contribution of each Eigen faces to the reconstruction of the given image.

$$w_k=u_k^{T}(r-\psi)$$

$$\theta\phi\Omega^{T}(w_1,w_2,\ldots\ldots,w_M)$$

Where u_k is the k^{th} eigenvector and w_k is the k^{th} weight in the vector.

$$\Omega^{T}_{new}=(w_1,w_2,\ldots\ldots,w_M)$$

3.3. Recognition Procedure

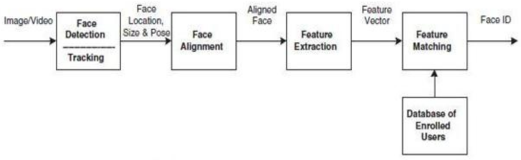
First, the image is transformed into its components
eigen faces according above formula

$$\Omega^{T}_{new}=(w_1,w_2,\ldots\ldots,w_M)$$

Then, the class of face providing the best description Of r_{new} is determined by calculating the minimal distance between the vector Ω^{T}_{new} and those stored in the data base. The most used metric is the Euclidean distance given by[2]:

$$D(X,Y)=\sqrt{\sum_{i=1}^{n}(xi-yi)^2}$$

A face r_{new} belongs to a class K when the minimum distance between Ω^{T} and $\Omega_k(1<K<M)$ is below a certain threshold , otherwise the face is regarded as unknown and can be possibly used to create a new class.



Face recognition processing flow.

4. RESULTS

The performance of face recognition is commonly evaluated using real time database with the help of different parameters. Different poses of 20 individuals are present in the real face database. A database of 20 images of different subjects is taken for experimentation.

Different parameters are:

1. **haarObj:** Haar classifier cascade in internal representation scaleFactor: The factor by which the search window is scaled between the subsequent scans, for example, 1.1 means increasing window by 10%

2.minNeighbors: Minimum number (minus 1) of neighbor rectangles that makes up an object. All the groups of a smaller number of rectangles than min_neighbors-1 are rejected. If min_neighbors is 0, the function does not any grouping at all and returns all the detected candidate rectangles, which may be useful if the user wants to apply a customized grouping procedure

3.flag: Mode of operation. Currently the only flag that may be specified is CV_HAAR_DO_CANNY_PRUNING. If it is set, the function uses Canny edge detector to reject some image regions that contain too few or too much edges and thus cannot contain the searched object. The particular threshold values are tuned for face detection and in this case the pruning speeds up the processing.

4.minSize: Minimum window size. By default, it is set to the size of samples the classifier has been trained on (~20x20 for face detection) The system was tested in some real-world situations and Fig presents a sequence of images captured by the robot's camera and processed by the real-time face recognition system.

5. CONCLUSION

The experiment showed that using proposed face detection is performed by using Haar based cascade classifier, Principal Component Analysis with Eigen vectors measure we can achieve very high recognition accuracy and low equal rates using real time database.

6. APPLICATIONS

1. Motion-based recognition: human identification based on gait, automatic object detection, etc.

2. Automated surveillance: monitoring a scene to detect activities or unlikely events

3. Video indexing: automatic annotation and retrieval of in multimedia databases

4. Human-computer interaction: gesture recognition, eye gaze tracking for data input to computers, etc.

5. Traffic monitoring: real-time gathering of traffic statistics to direct traffic flow 6. Vehicle navigation: video-based path planning and obstacle avoidance capabilities.

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