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A Novel Approach for Face Recognition Based on a Multiple Faces Database

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ABSTRACT

This paper presents an algorithm and then MATLAB program that can construct and process an image depending on a given database and face recognition technique, which helps in the operations of investigation issues for policemen and in any similar operations, the image gets constructed and implemented as the database is developed. It is found that such image processing operation helps in operations needs quick investigation transactions of some issues like policemen works and operations. The method depends on the given database about the face of the person, the face recognition depends on drawing a face of the given data and then comparing the resulted face with the stored data and find the most closes one and choose it to be its goal. This operation needs a time, it is not real-time operation but the time needed is too short. This method develop a method to make the operation of searching about some unknown person or face faster which helps more all sectors interested in searching about some unknowns in their transactions.

Keywords: Image-Processing; MATLAB; Database; Face Recognition; Searching

1. Introduction

Database image processing system is a suggested system that can hurry up building and constructing some image in urgent events such as criminals cases and policemen investigation transactions about killers, thieves and other cases. It can work side by side with image retrieval systems and other image processing utilities. The suggested system can make what is called image retrieval operation to make the comparison between the stored images in some database system and that drawn or created from the given data, then some queries can be carried out. On the one hand, non-semantic retrieval refers to those systems that access data based on attributes of the images. Some attributes of images can be extracted by using image processing techniques [1-3].

The system can start by taking the data from the source; such database describing the image and then any item in the database can be translated using the code constructed by the MATLAB into some image similar to that given by the database then the system search on a similar image of that constructed through a huge stored database. After that the system may reach to its goal and the unknown image becomes known and this followed by a test stage to be sure that the final image is true. Many researchers studied and analyze such systems with different methodologies such as: Jodouin S. *et al*. 2003, presented a fully automated approach for area detection and delineation based on multispectral images and features from a topographic database. The author presented a method to integrate the two approaches is proposed using an estimation of the maximum a posteriori (MAP) segmentation in an effort to form a unified approach that is robust to noise and poor edges [4]. Sean A. *et al*. 2011, searched in solving image-processing problems such as texture synthesis, resolution enhancement, image noise, and hole filling. The authors stated that: such problems are considered mathematically ill-posed, which means that the desired output contains more information than the input and then any algorithm looking to solve them must incorporate assumptions about our world to select a plausible result from the set of algebraic solutions [5].

Sasikumar G. *et al*. 2012, described a fast face detection algorithm with accurate result. They used Lip Tracking is one of the biometric systems based on which a genuine system can be developed. They used prerecorded visual utterance of speakers has been generated and stored in the database for future verification. The method consists of four stages: the first stage includes obtaining face region from the original image, the second stage includes mouth region extraction by background subtraction, the third stage includes key points extraction by considering the lip centroid as origin of coordinates and the fourth stage includes storing the obtained feature vector in the database [6]. The user who wants to be identified

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by the system provides the new live information, which is then compared with the existing template in the database. The feedback provided by the system will be a match or a miss-match. Sanjay K. *et al*. 2012, focused on the recognize a person's identity is important mainly for security reason, but it could also be used to obtain quick access to medical, criminal, or any type of records. Solving this problem is important because it could allow personnel to take preventive action, provide better service in the case of a doctor's appointment, or allow a person access to a secure area [7].

2. Face Recognition

Face recognition method refers to an automated or semi automated process of matching facial images it's a technique that can be used in defining some unknown images. Face recognition uses many utilities which are worked on face but use different scanning techniques. One of such techniques is 2D face recognition which is easier and cheap compared to the other approaches [6,8].

2.1. Face Recognition Process Steps

1) Acquiring a sample: a sensor takes an observation from biometric system. We can use any camera to be as a sensor and the observation is a snapshot picture.

2) Extracting Features: in this stage, the relevant data is extracted from the predefined captured sample. By using some software where many algorithms are available. A biometric template which is a reduced set of data that represents the unique features of the enrolled user's face is the result at this stage.

3) Comparison Templates: in this step there is a comparison between a given picture for the subject and all the biometric templates stored on a database.

4) Declaring a Match: The face recognition system will return a candidate match list of potential matches. All these steps are presented in **Figure 1**.

Then the photos are stored in a matrix X that every column represents an image, then computes the mean image and subtracts it from each image vector to simplify the implementation of PCA.

$$m = \frac{1}{M}\sum_{k=1}^{M} X_k \tag{1}$$

$$mX_k = X_k - m \tag{2}$$

where: M defines the person number, m: is the mean.

2.2. Training Stage

Step one: calculate the covariance

$$C_x = \frac{1}{M}\sum_{k=1}^{M} mXmx_{k'} \tag{3}$$

Step two: calculate the eigenvector matrix V = [Eigen vector, Eigen value] The eigenvectors and Eigen values of the covariance matrix are used to compute the Eigen faces.

Step three: features represented as Eigen faces vector which correspond to the eigenvectors of the C matrix.

$$U_k = \sum_{k=1}^{M} V_k mx_k \cdots k = 1,2\cdots M \tag{4}$$

Step four: calculate the vector of weights for the training images

$$W_k = u_k^T mx_k \cdots k = 1,2\cdots M \tag{5}$$

$$W = \left[w_1, w_2, w_3, \cdots, w_m\right] \tag{6}$$

When the number of images per person is greater than one, calculate the average weight of each person. Let's take example for training stage **Figures 2(a)-(c)**.

2.3. Recognition Stage

The recognition stage that features will be extracted from unknown image X_{new} to be compared with the stored feature of training image.

Step one: store the unknown image in vector form as in the **Figure 2**.

Step two: Finding differences of new image from the mean image.

Step three: calculate weights feature vector using the Eigen faces constructed in the training stage.

$$W_{k_{\text{new}}} = u_k^T \left(X_{\text{new}} - m\right) \cdots k = 1,\cdots,M \tag{7}$$

Step four: find the most suitable image using Euclidean distance measure

$$E_k = \sqrt{\left(\sum_{k=1}^{M}\left(w_k - w_{k_{\text{new}}}\right)^2\right)} \tag{8}$$

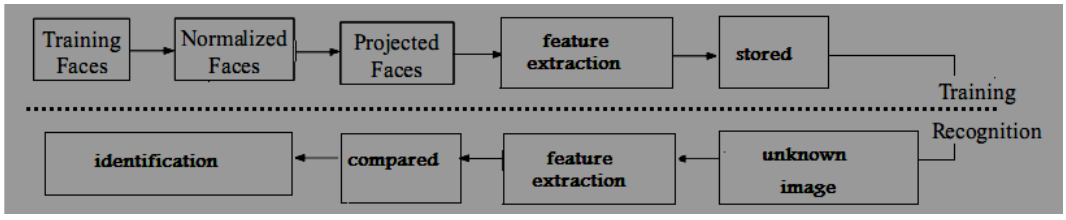

Figure 1. Face recognition block diagram.

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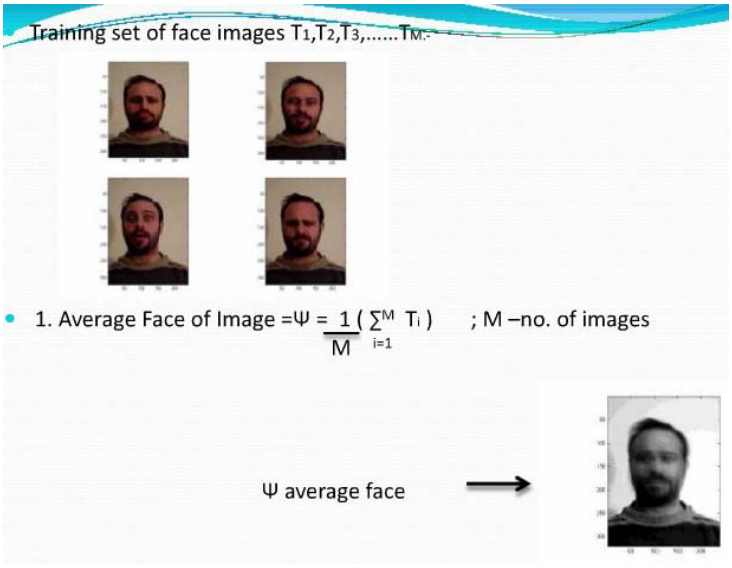
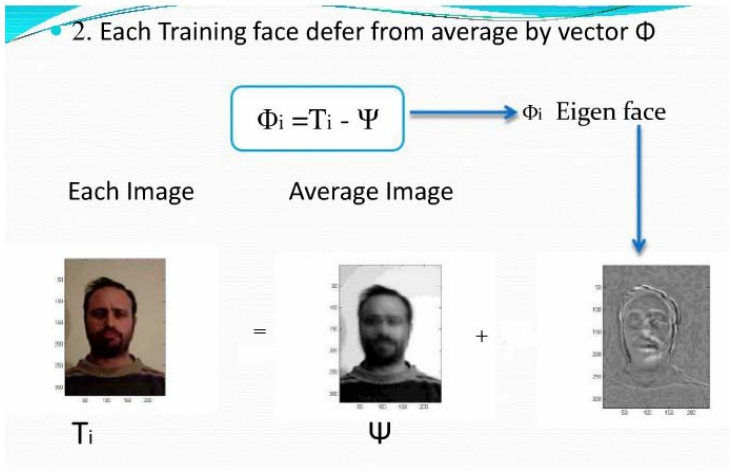
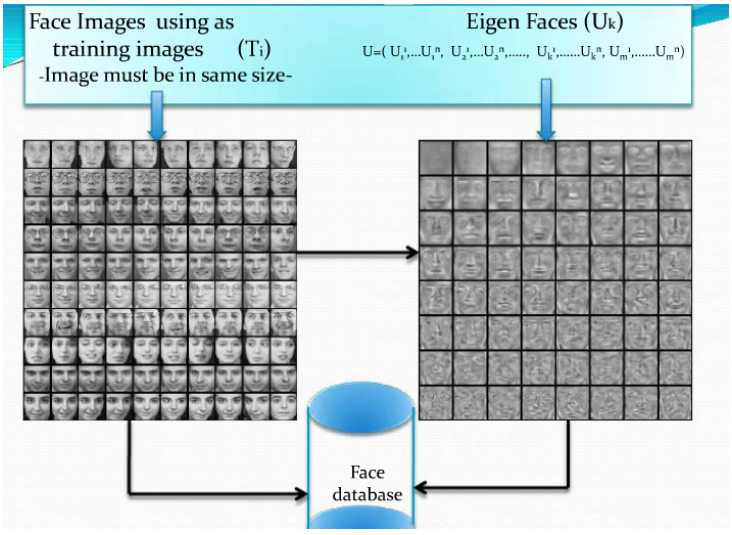


(a)



(b)



(c)

Figure 2. (a) Training stage; (b) Training stage; (c) Training stage.

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The closest image will be with the minimum distance Ek. see **Figure 3**.

2.4. Eigenvectors and Eigen-Values in MATLAB

Eigenvectors and Eigen-values is the core of calculations in MATLAB; because Face Recognition lies on Eigen-vectors and Eigen-values in calculating distances in the human face. Eigen faces can be produced as that in **Figure 3** as follows: for an N × N matrix, if λ is a real number called an Eigen-value of the N × N matrix, define a non-zero vector x in Rn such that Ax = λ x. The vector x is called an eigenvector belonging to λ. The expression $\{\det(A - \lambda I)\}$ is a polynomial in λ of degree n, called the characteristic polynomial, the Eigen-values are the roots of the characteristic equation $\det(A - \lambda I) = 0$.

3. Results and Discussion

The block diagram represents the image processing depending on a given database is shown in **Figure 4**. The method starts by input the database directly into the system using the MATLAB media utilities or program; the in- put data starts by a description of the face details, then the image processing code begin to construct a relatively similar image to the properties and description by the user. The next step is to construct the face details as the information progressed, the final step is to draw the final image of the face and comparing it with the stored data. As the database be accurate the final resulted image ap- pears faster.

Comparing to study done by Sanjay K. *et al*. (2012) as shown in **Figure 5** which First input a known image and observed the Euclidean distance. This distance tells us how close the input image is from the image on a training set. Based on maximum and minimum distances they can make a decision of whether the face is a known face, an unknown face or not a face at all [7]. This method gives a training set, normalized set and Eigen sets of faces:

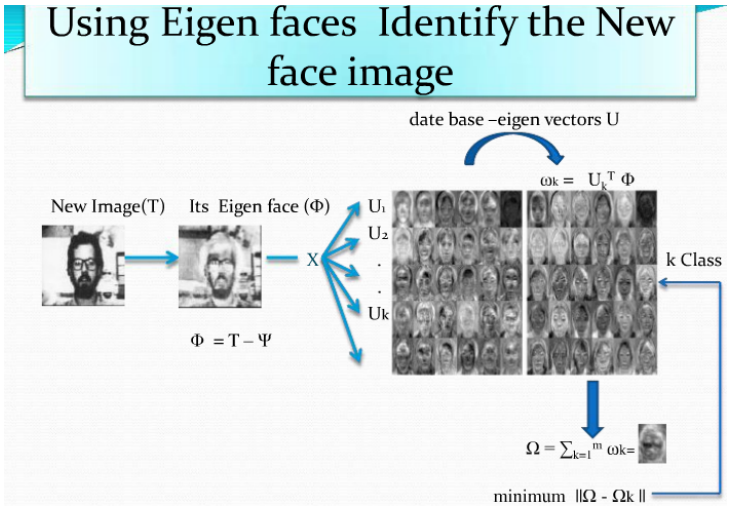

Figure 3. Eigen faces.

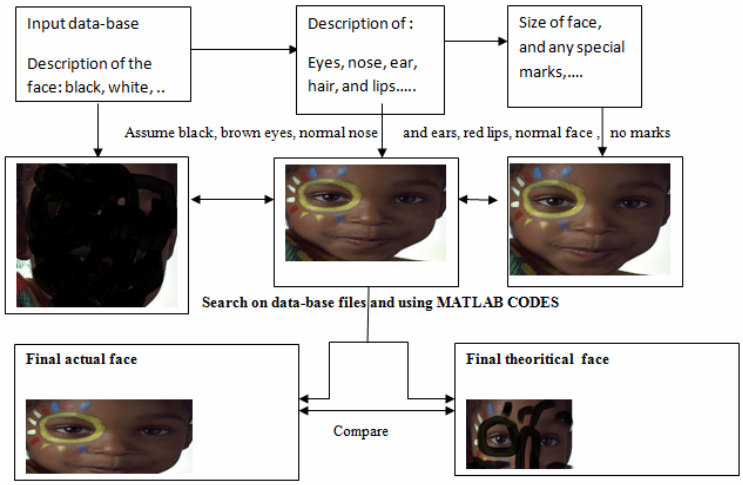

Figure 4. Image processing depending on database system and face recognition.

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Figure 5. Results of Sanjay K. method [7].

Another study made by Sasikumar G. *et al*. 2012, described a fast face detection algorithm with accurate result. They used Lip Tracking is one of the biometric systems based on which a genuine system can be developed. The proposed lip features can be used in conjunction with audio to improve the performance of the multimodal speaker identification systems. Person authentication can be realized by solely using visual lip features, the uses of shape-based lip features do not warrant acceptable performance.

The present method depends on knowing the face to about 90%. Then the program make quick comparing with stored faces and select the most closes one and gives the result [6]. Lips study done by Sasikumar G. presents a good method but I think that the human lips are not considered as a template or a thumb.

4. Conclusion

The suggested algorithm or the MATLAB program presents a good service in constructing an image for exactly unknown persons whom wanted to be known urgently. The Eigen faces are produced using MATLAB simulation and image processing techniques in order to complete the comparison operation between the stored face image and the created one using a given database.

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