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# Twin Based Face Differentiation and Retrieval from a Database

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**Abstract:** In face recognition technology, facial marks identification method is one of the unique facial identification tasks using soft biometrics. Also facial marks information can enhance the face matching score to improve the face recognition performance. As numbers of folk apply their face with cosmetic items.Some of the facial marks are invisible from their faces. Iris recognition is the most accurate biometrics which received increasing attention in departments which require high security. In this paper, we make a comparative study of performance of image transforms using principle of component analysis (PCA).The main aim of this paper is to show that how can we get better overall accuracy than the existing methods of feature extraction of iris recognition system.

**Keywords**: Face recognition, PCA, edge detection, Iris recognition, edge detection, CBIR, Facial marks detection and differentiating twins.

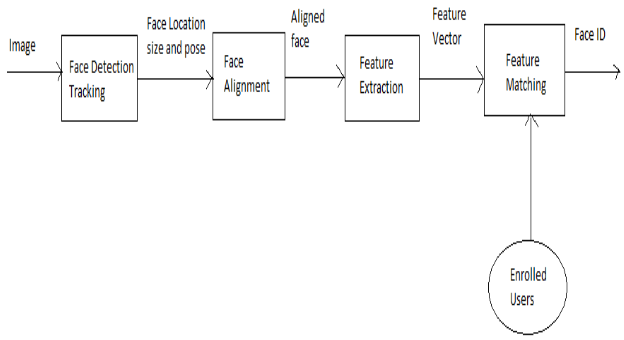
## I. INTRODUCTION

Face recognition is a biometric identification by scanning a person's face and matching it against a stored template. Face recognition can be used for both identification and verification. Shadows in images create lots of problems on image analysis. There is no need of shadow in an image i.e. shadow is unwanted part in images. Shadow affects the images because of shadow lots of data and information is lost from images. Security related an issue has become an important aspect in each and every organization. Every organization requires that there security methods should be as efficient as possible. Development are being made day by day to enhance and improve the security. One such efficient method that is brought forward by means of this paper is biometric. Biometric refers to the use of psychological or biological. Characteristics of human beings to determine the identity of the person. Identification of person is very important and is done is the most of the important sites such as banks, airports, companies and many more to identify the identity of the person. There are various methods to do the job such as assigning Id and password which is also called as knowledge based processing. But these approaches have limitation. Face recognition and speech recognition have also been widely studied over the last 30 year, whereas this recognition is a newly emergent approach to personal identification in the last decade among all biometrics (such as finger print, face, print, giant, voice, iris, dental radiographs etc.),iris recognition is the most consistent one. The iris is a thin circular diaphragm, which lies between the cornea and the lens of the human eye. The pattern the human iris differs from person to person there are not ever two iris alike not even for genetically identical twins. The iris is considered one of the most stable biometrics as it is believed to not change significantly during a person's life time and its physiological response to light which provides the detection of a dead or artificial iris, avoiding this kid of counterfeit? Other properties of the human iris that increase its suitability for use in automatic identification include its inherent isolation and protection from the external environment, being an internal organ of the eye, behind the cornea and the aqueous humans.

### 1.1 Primary Iris Recognition Process:

A typical iris recognition system is schematically. The whole iris recognition process is basically divided into steps:

1) Image acquisition;
2) Iris image preprocessing;
3) Iris feature extraction; and
4) Matching




A typical iris recognition system is schematically. The whole iris recognition process is basically divided into four steps 1) Image acquisition 2) Iris image preprocessing 3) Iris feature extraction 4) Matching. Now a day, various algorithms for iris recognition have been presented. For therefore, the preprocessing of iris image includes four aspects: localization, normalization, enhancement, delousing, and the selection of iris valid areas. Various algorithms have been applied for feature extraction and pattern matching processes. These methods use local and global features of the iris. A great deal of advancement in iris recognition has been made through these efforts;

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therefore, a detailed performance comparison of all these algorithms is necessary. The goal of this paper is to compare feature extraction algorithm based on PCA, Haar transform, Facial marks detection and differentiating twins Algorithm.

## II. PROPOSED METHODOLOGY

Facial marks detection and differentiating twins

Below are the steps that are involved in this algorithm

**Step 1: Apply skin segmentation algorithm to detect skin pixels in face region found** In this section, a mixture vector containing RGB-YCbCr color components and their relative functions including color ratio, color difference and absolute difference is created for skin detection. RGB color space was adopted due to its simplicity, effectiveness, and speed retaining of all color information. YCbCr was selected in that the disadvantage of RGB may be compensated. Below are the sub-steps that results in final output at this step. Give the RGB values YCbCr values are evaluated as below

$$\begin{bmatrix} Y \\ C_b \\ C_r \end{bmatrix} = \begin{bmatrix} 16 \\ 128 \\ 128 \end{bmatrix} + \frac{1}{256}\begin{bmatrix} 65.738 & 129.057 & 25.064 \\ -37.945 & -74.494 & 112.439 \\ 112.439 & -94.154 & -18.285 \end{bmatrix}\begin{bmatrix} R \\ G \\ B \end{bmatrix} \quad \text{.... (12)}$$

After converting to YCbCr, skin pixels are found by thresholding and connected components generated by command bwconncomp.

**Step 2: Preprocessing of image for contrast enhancement and smoothening**

This step is motivated by two widely accepted assumptions about human vision [39]:

- Human vision is mostly sensitive to scene reflectance and mostly insensitive to the illumination conditions.
- Human vision responds to local changes in contrast rather than to global brightness levels. These two assumptions are closely related since local contrast is a function of reflectance.

Having these assumptions in mind our goal is to find an estimate of L(x, y) such that when it divides I(x, y) it produces R(x, y) in which the local contrast is appropriately enhanced. In this view R(x, y) takes the place of perceived sensation, while I(x, y) takes the place of the input stimulus. L(x, y) is then called perception gain which maps the input sensation into the perceived stimulus, that is:

$$I(x,y)\frac{1}{L(x,y)} = R(x,y) \quad \text{.......................... (13)}$$

With this biological analogy, R is mostly the reflectance of the scene, and L is mostly the illumination field, but they may not be correctly separated in a strict physical sense. After all, humans perceive reflectance details in shadows as well as in bright regions, but they are also cognizant of the presence of shadows. From this point on, one may refer to R and L as reflectance and illuminance, but they are to be understood as the perceived sensation and the perception respectively.

**Step 3: Implementation of LOG filter**

Gaussian function is given by the following expression.

$$G(x,y) = -e^{-\frac{x^2+y^2}{2\sigma^2}} \quad \text{..............................(14)}$$

Then the Laplace of Gaussian is given by (15)

$$\nabla^2 G(x,y) = -[\frac{(x^2+y^2)-\sigma^2}{\sigma^4}]e^{-\frac{x^2+y^2}{2\sigma^2}} \quad \text{.......... (15)}$$

At first image is convoluted with Gaussian filter which introduces Gaussian blurring, which in effect cause reduction of noise. Then laplacian of the result is taken. It is same as convolving the function with the given entire function (14). A double edge image is produced, due to the laplacian operation. Zero crossing between the double edges represents the edges [40] [41].

**Step 4: Implementation of edge detection technique to get dominant edges in the image.**

Canny Edge Detection is a popular edge detection algorithm. It was developed by John F. Canny in 1986 [41].It is a multi-stage algorithm and go through following steps.

- Noise Reduction
  Since edge detection is susceptible to noise in the image, first step is to remove the noise in the image with a 5x5 Gaussian filter.
- Finding Intensity Gradient of the Image
  Smoothened image is then filtered with a Sable kernel in both horizontal and vertical direction to get first derivative in horizontal direction (Gx) and vertical direction (Gy). From these two images, we can find edge gradient and direction for each pixel as follows:

$$Edge\_Gradient\ (G) = \sqrt{G_x^2 + G_y^2}$$

$$Angle\ (\theta) = \tan^{-1}\left(\frac{G_y}{G_x}\right)$$

Gradient direction is always perpendicular to edges. It is rounded to one of four angles representing vertical, horizontal and two diagonal directions.

- Non-maximum Suppression
  After getting gradient magnitude and direction, a full scan of image is done to remove any unwanted pixels which may not constitute the edge. For this, at every pixel, pixel is checked if it is a local maximum in its neighborhood in the direction of gradient. In short, the result you get is a binary image with "thin edges".
- Hysteresis Thresholding
  This stage decides which are all edges are really edges and which are not. So a threshold value is used which decide edges and non-edges.

**Step 5: Implementation of morphological operations to filter out facial marks**

A morphological operation on a binary image creates a new binary image in which the pixel has a non-zero value only if the test is successful at that location in the input image.

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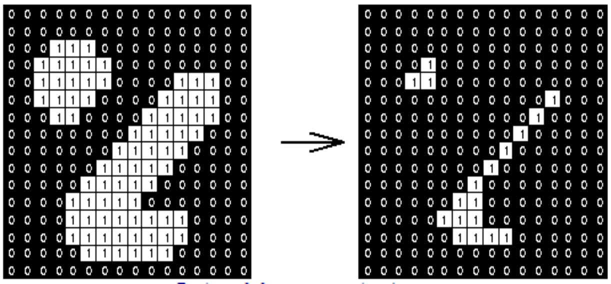
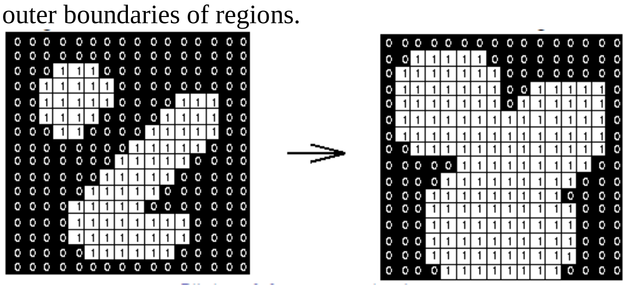
The structuring element is a small binary image, i.e. a small matrix of pixels, each with a value of zero or one:

- The matrix dimensions specify the size of the structuring element.
- The pattern of ones and zeros specifies the shape of the structuring element.
- An origin of the structuring element is usually one of its pixels, although generally the origin can be outside the structuring element.

**Erosion Operation:**
Erosion with small (e.g. 2×2 - 5×5) square structuring elements shrinks an image by stripping away a layer of pixels from both the inner and outer boundaries of regions. The holes and gaps between different regions become larger, and small details are eliminated:



**Dilation Operation:** The **dilation** of an image *f* by a structuring element *s* (denoted $f \oplus s$) produces a new binary image $g = f \oplus s$ with ones in all locations (*x, y*) of a structuring element's origin at which that structuring element *s*hits the the input image *f*, i.e. $g(x, y) = 1$ if *s* hits *f* and 0 otherwise, repeating for all pixel coordinates (*x*,*y*). Dilation has the opposite effect to erosion -- it adds a layer of pixels to both the inner and outer boundaries of regions.



Step 8: Apply Bwlabeln function to get connected components separately

L = bwlabeln(BW) returns a label matrix, L, containing labels for the connected components in BW. The input image BW can have any dimension; L is the same size as BW. The elements of L are integer values greater than or equal to 0. The pixels labeled 0 are the background. The pixels labeled 1 make up one object; the pixels labeled 2 make up a second object; and so on. The default connectivity is 8 for two dimensions, 26 for three dimensions.

**Step 6: Detection of facial marks using circular blob detection containing marks**
Circular Hough transform localize the circular blobs in the image. A radius range has been given to find strongest circles in the binary image. It also gives the co-ordinates of the marks found in the image.

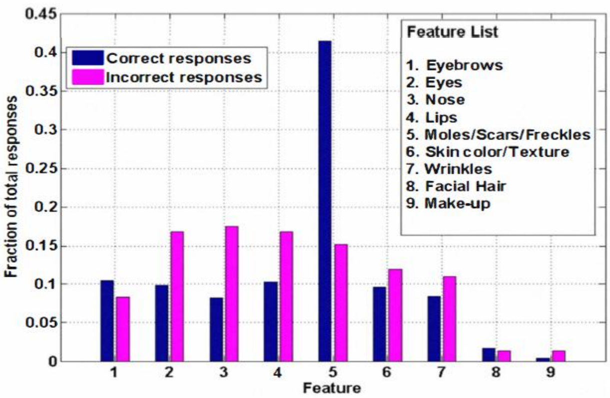
**Step 7: Evaluating feature vector for differentiating containing coordinates of facial marks and its distance with center of mass of face region.**

Step 8: Differencing twins based on features of input image and images in the trained data based on similarity judgment based on location of facial marks.

## III.RESULTS AND DISCUSSIONS

The dataset consists of face images of identical twins acquired in two days of August, 2009 at the Twins Days Festival in Twinsburg, Ohio [46]. Twenty twin pairs are chosen randomly by searching on internet related to Ohio Twins Days Festival. Facial marks are Level 3 features that can be used to distinguish between identical twin pairs. The facial marks used in previous work [10] were manually annotated on all images by a single examiner.

The facial mark matching results were considered optimistic due to the use of a single examiner to label the images. In study done by [47], given a pair of facial images, the participants were asked to choose the facial features which helped them in making their decision. From the figure, it is evident that for the correct responses, the most important feature type chosen is moles/scars/freckles and it is significantly more important than any of the other types. For the incorrect responses, none of the features seem significantly more important than the others. This observation suggests that humans are more likely to be incorrect in their decision if they cannot find moles/scars/freckles in the images. It is also found in their study that if none of the images have any moles/scars/freckles it makes it difficult for humans to respond correctly.




We took biological motivation for our work from this study and decided to differentiate twins based on this biological fact. The algorithms we proposed in Chapter 3 are shown along with experimental results at each step. This will help in understand the algorithms deeply along with visual results. In the experimental results only one image is explained thoroughly; however results for all images can be displayed while running the algorithm, some of the results with facial marks markings has been displayed in the last.

Results and discussions for algorithm one:

Step 1: Load an image in MATLAB workspace

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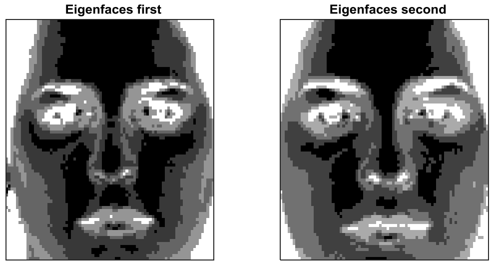
Step 2: Evaluate face area as ROI using vision Cascade Object Detector.


Step 3: Applying fuzzy-c-means clustering for segmenting image into limited regions


Step 4: Retrieved results after applying PCA algorithm


Identical twins found

Step 6: Results showing Eigen vectors projected on retrieved images also known as Eigen faces.




Eigen faces projected for two images using PCA algorithm.

## IV. CONCLUSION

The use of face recognition in forensic applications is becoming more and more common, especially because when other biometric modalities may not be available. Law enforcement and security agencies around the world are using face recognition to detect fraud and to identify unknown individuals depicted in the act of committing crimes, even when fingerprints or DNA may not be left behind. Similarly civil programs, such as driving licensing and passport issuance, use face recognition to detect duplicate applicants because the face has long had social acceptance in identity credentials and because capture equipment is so widely available. When utilizing such biometric tools, however, it is important that mis-identifications be avoided to minimize - or eliminate - the chance of inadvertently implicating an innocent person.

Face recognition system is expected to identify faces presented in images and videos automatically. Face verification (or authentication) and face identification (or recognition) are two important aspects of face recognition systems. Face verification is concerned with validating the claimed identity of a person based on the face image available, in other words it is considered as one to one match while face identification involved in identifying a person based on the face image by comparing it with all the registered persons or equivalently one to many matching. The existed techniques found in face verification and identification deals with global features of the person which results in wrong classification when there are identical twins in the images. So in this work, we proposed a method which uses scars, facial marks, moles etc. as features to differentiate identical twins in the image. As these features vary from person to person, it is easy to recognize them according to the location of these features in identical twin images. In this work, first of all, we automatically find the location of facial marks of each individual and they are matched with all identical twins which are in the database. The method fails when it is not able to find any scar or facial marks on an individual which turns in the failure of the proposed work.

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