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Gender Classification via lips Based on PCA and Gabor Wavelet Using Simulink in Matlab

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Abstract— **In this technical paper, an ingenious approach explained and developed with respect to face recognition and gender classification via Lip detection feature: a computer system which can authenticate a person by comparing the individuals for face recognition and gender classification via lip detection feature. In a recent research biometric recognition become the realistic target for the automation of biometric research, among them face recognition is reliable recognition. The extraction for lip detection is carried by using Principle Component Analysis (PCA), and Gabor Wavelet. For this purpose the algorithm takes the color image RGB and redesign into YCbCr color, but for easy recognition the redesigned image is converted to a grey color image for detecting the skin region in the facial image. This practice pinpoints the lip region and mouth region. The gender classification practice classifies almost all the images with different image sizes for achieving best ranking rate by using the methods given in this work. Recognition is practiced with the photographs of a person and showed that this method can secure maximal of 96-97% first one recognition rate and 0.4-0.5% Equal Error Rate.**

Index Terms: **Face Recognition, Gender Classification, Principal Component Analysis (PCA), Gabor Wavelet, Eigenvalues, Eigenvector.**

I. INTRODUCTION

Biometric is becoming the most unique identification measuring for the study of methods making unique biological and psychological characters or verifying the individual's identity. It is easy to a human to identify whether the person is male or female, but it is difficult for a computer; for the purpose this paper adopts different methods to identify a human face with the help of computer using Simulink in Matlab. In the near future it will have more précised method for the identification of human identification. There are distinct biometric methods comparatively as face recognition, fingerprint identification, iris localization, palm-vein acknowledgment, signature analysis etc. But we need to scrutinize futuristic methods of authentication that find the more profound work for the next generation researchers. This leads us to identification and authentication using Face Recognition System and Simulink in Matlab.

This proposed system is designed using Simulink in Matlab with a new technique for Face Detection and Gender Classification by using the features extraction of lips. Lip based detection is one of the major biometric systems identification based on which a genuine identification of a human face system can be developed which has high advantage of making the system more secured. This proposed design tells us that whether the give facial image is male or female. The proposed system combines the face detection and gender classification methods to improve the level of security. The face detection acts as a pre-processing step for the gender classifier that determines the gender of the individual. The most important factors are accuracies of detection and classification of images, and also includes the other important factors like face detection and gender classification speeds, selection of the color space to detect skin region, the connection between face detection and gender classification are trained experimentally. Face detection approach captured surveillance image and compared with the digital photos in the database. That method gave a better view point for the security point of view. Face recognition technique increasingly becoming popular and plays a major role in daily life. Now it is being used to identify missing children, passport fraud, identify fraud etc [3].

As we know human face is an extremely complex dynamic structure with characteristics that can significantly change with the time. The human ability to recognize face is phenomenal, human can recognize thousands of faces in a lifetime; but after some time gap the human is unable to recognize them. It is only due to the face variability; here face recognition is profound for the role in human life and ingenious research area in the field of computer vision [4].

In this system face recognition method depends on feature derivation and analysis to gain the required knowledge about face. Facial features may be skin color, face shape, or facial features like mouth, eyes and nose. All the face and skin recognition algorithms, the 2-D image are used. The thresholding values (of graveness) are applied on the image to determine the skin region on the face. The face feature area is calculated, such as mouth, eyes and nose are estimated though the lip point detection and applying the standard procedure for thresholding values of measurement (in pixels) to get the entire portion of the features. Lips have certain advantages over the more established biometric trademarks like ear, palm-vein, fingerprint etc; they have rich and stable structure that is uphold even at the old age. The Lips sizes are bigger when compared with iris, retina, and fingerprint and therefore is more accurately captured.

Here Simulink in Matlab is used to take input of images for verification of image for future aspiration. In this system Feature extraction is carried out by using two methods namely PCA transform and Gabor wavelet. After the Simulink transformation feature extracted image is given for testing and identification of the gender in the Matlab environment is processed by using Minimum distance classifier method

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which gives the output either the input image is man or women.

The paper is organized in the following manner: first literature review of different methods is mentioned, followed by system development, conclusion and finally references.

II. Literature Survey

This section gives an overview on major human face recognition and gender classification methods that are applied mostly on frontal faces. The main issues of the face recognition and gender classification are selection of the color space to detect skin region, face recognition and gender classification methods. The Matlab Simulink takes the image input to gain the required knowledge about face, bur for face detection in feature-based approach, the apparent properties of the face such as skin color and face geometry are exploited over lifetime of human being. Feature-based face recognition method depends on feature derivation and analysis to acquire the required knowledge about face. Facial features may be skin color, face shape, or facial features like mouth, eyes and nose. All the face and skin recognition algorithms, the 2-D image are used. The thresholding values (of graveness) are applied on the image to determine the skin region on the face. The face feature area is calculated, such as mouth, eyes and nose are estimated though the lip point detection and applying the standard procedure for thresholding values of measurement (in pixels) to get the entire portion of the features.

Evaluation of Gender Classification Methods with Automatically Detected and Aligned Faces [1]. In this paper the study and comparison of four fundamentally different gender classification methods and four automatic alignment methods included together with non-aligned faces and manually aligned faces. They are also analyzed how classification accuracy was affected when face image resizing occurred before or after alignment. Finally, they conduct a sensitivity analysis for the classifiers by varying rotation, scale and translation of the face image.

Gender Classification with Matlab Simulink presents a systematic study on gender classification with automatically detected and aligned faces [2]. Here Matlab environment provides the training a dataset with experimented images with 120 combinations of automatic face detection, face alignment and gender classification. One of the findings was that the automatic face alignment method did not increase the gender classification rates. However, manual alignment increased classification rates a little, which suggests that automatic alignment would be useful when the alignment [11] methods are further, improved.

III. System Development

Computer vision based gender classification is an important component in visual surveillance systems [5]. In this paper, it is exploring gender classification from human gaits in video frames, a relatively understudied problem. Moreover, it proposes to fuse gait and face for improved gender selectivity.

Conventional Face recognition and gender verification system is illustrated in Fig 1. A Face Recognition and Gender Verification System comprising of image acquisition and software elements is proposed. An image taken from database is used for input face image acquisition. The software architecture of the system involves the use of MATLAB version R2014b. MATLAB was used to perform the pre-processing, feature extraction and verification processes. The block diagram shows the system composed with the following four subsystems:

- Image acquisition
- Pre-processing
- Feature extraction
- Face Recognition and Gender Verification

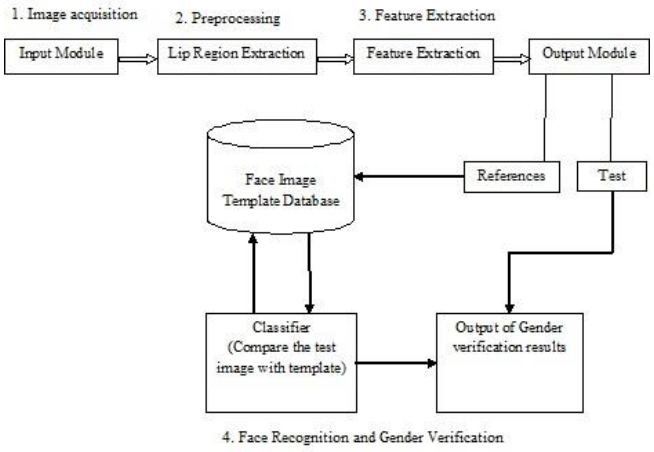

Figure 1: Block Diagram

As stated in Fig 1 the face recognition is carried out by some steps which show the process of Face Recognition and Gender Verification. In 'Face Detection in color images Using 'AdaBoost algorithm' based on skin color information [9] the differences in skin color appearance perceived is mainly due to the darkness or fairness of the human skin, which is characterized by difference in brightness of the skin color, which are supervised by following steps:

STEP 1: IMAGE ACQUISITION

➢ *INPUT IMAGES:*

Image Acquisition Toolbox enables to acquire images and video from cameras and frame grabbers directly into Matlab and Simulink. Generally an image is a 2-D function f(x, y) (here x and y are plane coordinates).The amplitude of image at any point say f is called intensity of the image. It is also called the gray level of image at that point. We need to convert these x and y values to finite discrete values to form a digital image. The input image is a fundus taken from stare data base and drive data base. The image of the retina is taken for processing and to check the condition of the person. We need to convert the analog image to digital image to process it through digital computer. Each digital image composed of a specific elements and each specific element is called a pixel.

IMAGE RESIZING/SCALING:

Image scaling occurs in all digital photos at some stage whether this is in Bayer de-mosaicing or in photo enlargement. It happens anytime you resize your image from one pixel grid to another. Image resizing is necessary when

you need to increase or decrease the total number of pixels. Even if the same image resize is performed, the result can vary significantly depending on the algorithm Images are resized because of number of reasons but one of them is very important in our paper. Every camera has its resolution, so when a system is designed for some camera specifications it will not run correctly for any other camera depending on specification similarities. So it is necessary to make the resolution constant for the application and hence perform image resizing.

➢ RGB to GREY Conversion:

In RGB color model [6], each color appears in its primary color spectral components of red, green, blue. The color of a pixel is made of three components; red, green and blue (RGB), characterized by their corresponding intensities. Color components are also known as color channels or color planes (components). In RGB color model, a color image can be represented as an intensity function.

$$I_{RGB} = (F_R, F_G, F_B)$$

Where F_R (x,y) is the intensity of the pixel (x,y) in red channel, similarly F_G (x,y) and F_B(x,y), are the intensity of pixel (x,y) in green channel and intensity of pixel (x,y) in blue channel.

In grayscale images, however, we do not differentiate how much we emit of different colours; we emit the same amount in every channel. We will be able to differentiate the total amount of emitted light for each pixel; little light gives dark pixels and much light is perceived as bright pixels. When an RGB image is converted to grayscale level image, we have to consider the RGB values for each pixel and make as output which gives a single value, reflecting the brightness or intensity of that pixel where (x,y) denotes the spatial coordinates when only the brightness of light is considered. Sometimes 3-D spatial coordinates are used. One of the approaches is to take the average of the contribution from each channel (component): (R+B+C)/3. However, since the perceived brightness is often dominated by the green component, a different, more "human-oriented", method is to consider a weighted average, example: 0.3R + 0.59G + 0.11B.

STEP 2: PRE-PROCESSING

➢ LIP DETECTION:

Lip Features are usually extracted from the image or video frames using a process in which the lip region is detected [7][8]. In this paper the lip region is content of the video frame, it may be necessary to start the lip detection with a face-detection stage which returns the random location of the face in the video frame taken. The consecutive stage is to localize the face and mouth regions of the provided image and gives the cropped image of the humans face's mouth.

The lip parameterization stage is geometric based or image transform based. Petajn's original system [10] is an example for geometric-based feature extraction which used simple thresholding of the mouth image to enhance the lip region and then the measurements of the mouth height, width and region were taken from that. Since many approaches are developed, this exploits the knowledge of the shape of a human mouth to fit more complex models to human mouths.

The Lip detection in MATLAB carries the output by cropping the lip region from the whole face image using train_pca.m. The train_pca.m give the lip region with the red mark on the face. After lip detection the process is done for segmenting image acquisition by thresholding.

➢ THRESHOLDING

After lip detection Otsu's thresholding is done for the segmented image acquisition; thresholding is the important part of the whole system. Image thresholding is a simple but yet an effective way for partitioning of an image from a foreground into background. This image analysis technique is a type of image segmentation that isolates the object by converting grayscale images into binary images for a high level of contrast. Image thresholding is most effective in the image enhancement with high level of contrast.

Common image thresholding algorithms include histogram [12] and multi-level thresholding. The following example shows how to correct nonuniform illumination in an image to make it easy to identify individual lip region from a face image. First read the image, then it uses Morphological opening to estimate the background, then subtract the background image from the original image, then it increases the image contrast, then is threshold the image, for correction it examine one object and view all objects, then compute area of each object and also compute area-based statistics is done and finally creates the histogram of the area.

After thresholding of the image the histogram images are further enhanced with the help of EDGE DETECTION technique for the right feature extraction of the lip region.

STEP 3: FEATURE EXTRACTION

➢ EDGE DETECTION:

Edge detection is the name for a set of mathematical methods which aim at identifying points in a digital image at which the image brightness changes sharply or, more technically, has discontinuities or noise. The points at which image brightness alters sharply are typically organized into a set of curved line segments termed edges. The same problem of detecting discontinuities in 1D signal is known as step detection and the problem of finding signal discontinuities over time is known as change detection. Edge detection is a basic tool in image processing, machine vision and computer envisage, particularly in the areas of feature reveal and feature extraction

EDGE DETECTION TECHNIQUES:

Different colors have different brightness values of particular color. Green image has more bright than red and blue image or blue image is blurred image and red image is the high noise image. Following are list of various edge-detection methods:-

- Sobel Edge Detection Technique
- Perwitt Edge Detection
- Roberts Edge Detection Technique
- Zerocross Threshold Edge Detection Technique
- Canny Edge Detection Technique

In this paper the technique used is "**CANNY EDGE DETECTION TECHNIQUE**" because of its various advantages over other edge detection techniques

- *Canny Edge Detection*

The Canny method is one of the most commonly used image processing tools detecting edges in a very robust manner. It is a multi-step process, which can be implemented on the GPU as a sequence of filters. Canny method is based on three basic objectives.

I. Low error rate:-All edges should be found, and there should be no spurious responses, i.e.; the edges must be as close as possible to the true edges.

II. Edge point should be well localized:-The edges located must be as close as possible to the true edges. That is, the distance between a point marked as an edge by the detector and the centre of the true edge should be minimum.

III. Single edge point response:-The detector should return only one point for each true edge point. That is, the number of local maxima around the true edge should be minimum. This means that the detector should not identify multiple edge pixels where only a single edge point exists. The essence of Canny's work was in expressing the preceding three criteria mathematically and then attempting to find optimal solution to these formulations, in general, it is difficult to find a close form solution that satisfies all the preceding objectives. However, using numerical optimization with 1-D step edges corrupted by additive while Gaussian noise led to the conclusion that a good approximation to the optimal step edge detector is the first derivative of Gaussian:

Canny method is performed for perfect shape analysis to be done in the program developed. Once the shape analysis is over, then we may proceed for the feature extraction of lips and then to identify the gender of the particular individual. The process is programmed in Matlab.

After step 3 is completed we have grayscale image, lip detected, thresholding of the lip image and canny edge detected image as shown in the fig 2 and 3. For test verification of gender identification, step 4 is implemented using PCA and GABOR WAVELET.

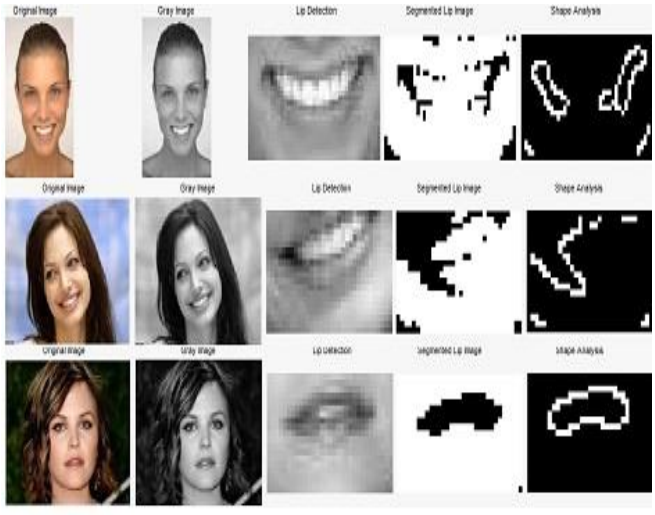

Figure 2: Images after lip detection, thresholding and edge detection for female gender.

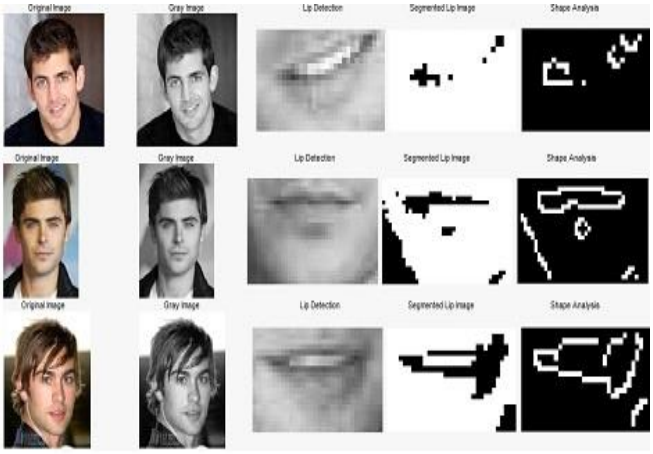

Figure 3: Images after lip detection, thresholding and edge detection for male gender.

STEP 4: FACE DETECTION AND GENDER VERIFICATION

➢ PCA Method

The purpose of PCA is to reduce the large dimensionality of the data space to the smaller intrinsic dimensionality of feature space (independent variables), which are needed to describe the data economically. This is the case when there is a strong correlation between observed variables. The jobs which PCA can do are prediction, redundancy removal, feature extraction, data compression, etc. Because PCA is a classical technique which can do something in the linear domain, applications having linear models are suitable, such as signal processing, image processing, communications, etc. Face recognition has many applicable areas; moreover, it can be categorized into face identification, face classification, or gender determination. Starting from the successful low dimensional reconstruction of faces using PCA projections Eigen pictures have been one of the major driving forces behind face representation, detection, and recognition. It is well known that there exist significant statistical redundancies in natural images. For a limited class of objects such as face images that are normalized with respect to scale, translation, and rotation, the redundancy is even greater. Computing the eigenvectors Performing PCA directly on the covariance matrix of the images is often computationally infeasible.

➢ GABOR WAVELET METHOD

The Gabor transform is like the short time Fourier transforms. A set of Gabor filters with different frequencies and orientations may be helpful for extracting useful features from an image. Gabor filters are examples of Wavelets having two bases for images. The Gabor transform can be explained as: Its impulse response is defined by a sinusoidal wave (aplane wave for 2D Gabor filters) multiplied by a Gaussian function [13]. Because of the multiplication-convolution property the Fourier transform of a Gaborfilter's impulse response is the convolution of the Fourier transform of the harmonic function and the Fourier transform of the Gaussian function. The filter has a real and an imaginary is more concentrated than the rectangular function in the frequency domain, the frequency resolution of the Gabor transform is much better than short time Fourier transform, Gabor transform.

➢ GENDER IDENTIFICATION

In this paper, face recognition and gender identification is carried out by feature extraction of lips and for extraction purpose PCA and Gabor filter are used. The extracted features of lips are then stored in the database known as training set and are then compared with the test image from test set. For the gender identification of particular individual the Minimum distance classifier method gives the best result with no extra efforts. Out of two techniques i.e. PCA and Gabor used for feature extraction the results of Gabor filter are more accurate and fast because it is having less leakage in time frequency domain.

IV. Results And Discussion

The performance of system is determined based on the accuracy of classification between the genuine and forged face image. Evaluation parameters for any fingerprint verification system are FAR and FRR. Standard definitions of performance evaluation parameters i.e. False Acceptance Rate, False Rejection Rate is as follows:

A. False Acceptance Rate (FAR)

The probability is that a system will incorrectly identify an Individual or will fail to reject an imposter. It is also called as type 2 error rate.

FAR= NFA/NIIA

Where FAR= false acceptance rate

NFA= number of false acceptance

NIIA= number of imposter identification attempts

System identifies 7 persons correctly out of 10 person's database. Database contains 10 images of each person.

B. False Rejection Rates (FRR)

The probability is that a system will fail to identify an enrollee. It is also called type 1 error rate

FRR= NFR/NEIA

Where FRR= false rejection rates

NFR= number of false rejection rates

NEIA= number of enrollee identification attempt

Figure 2: Output for Female Gender

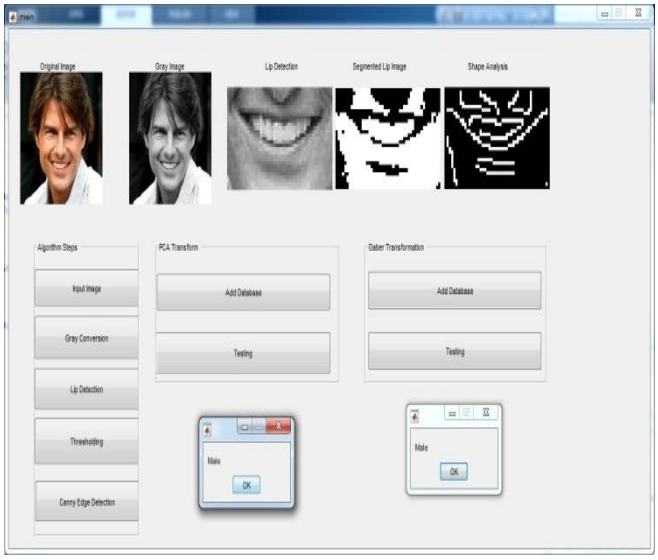

Figure 3: Output for Male Gender

V. Conclusion

It is very easy for a human being to identify whether a person is a male or female but when it came to a system it is somewhat complex to identify in some cases. Image-based face recognition is still a very challenging topic after decades of exploration. A number of typical algorithms are presented, being categorized into appearance-based and model based schemes. Sensitivity to variations in pose and different lighting conditions is still a challenging problem. A Face recognition has been an attractive field of research for both neuroscientists and computer vision scientists. Those researches illuminate computer vision scientists' studies. Although designers of face recognition algorithms and systems are aware of relevant psychophysics and neurophysiological studies, they also should be prudent in using only those that are applicable or relevant from a practical/implementation point of view.

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References

[1] Erno Makinen and Roope Raisamo, "Evaluation of Gender Classification Methods with Automatically Detected and Aligned Faces", IEEE Transaction on Pattern Analysis and Machine Intelligence, vol. 30, N0. 3, March 2008.

[2] B. Moghaddam and M.-H. Yang, "Gender Classification with Support Vector Machines," Proc. Int"l Conf. Automatic Face and Gesture Recognition, pp. 306-311, Mar. 2000. 2010 Special Issue - International Journal of Imaging Science and Engineering 5

[3] Shang-Hung Lin, "An introduction to face recognition technology", Informing Science Special Issue on Multimedia Informing Technology-Part-2, Vol. 3 No. 1, 2000.

[4] Andrew W.Senior and Ruud Mnitio. Bole, "Face recognition and its applications", NY 10598 USA.

[5] S. Siatras, N. Nikolaidis and I. Pitas .Visual speech detection using mouth region intensities,. in *Proc. of European Signal Processing Conf. (EUSIPCO 2006)*, Florence, Italy, 4-8 September, 2006.

[6] T. Ojala, M. Pietikinen, and T. Menp. Multiresolution gray-scale and rotation invariant texture classification with local binary patterns. *IEEE Trans. on PAMI*, 24:971–987, 2002.

[7] Paul Kuo, Peter Hillman and John Hannah, "Improved Lip Fitting and Tracking For Model-Based Multimedia and Coding", International Conference on Visual Information Engineering Conference, Glasgow, UK, pp. 251-258, 2005.

[8] Mohammad Sadeghi, Josef Kittler and Kieron Messer, "Segmentation of Lip Pixels For Lip Tracker Initialization", International Conference on Image Processing, ICIP, IEEE, Greece, 2001.

[9] Yan-Wen Wu, Xue- Yi Ai, "Face Detection in color Images Using AdaBoost algorithm based on skin color information"2008 Workshop on Knowledge Discovery and Data Mining

[10] T. Ahonen, A. Hadid, and M. Pietik¨ainen. Face description with local binary patterns: application to face recognition. *IEEE Trans. on PAMI*, 28:2037–2041, 2006.

[11] E. Makinen and R. Raisamo. Evaluation of gender classification methods with automatically detected and aligned faces. *IEEE Trans. on PAMI*, 30:541–547, 2008.

[12] A. Barla, F. Odone, and A. Verri. Histogram intersection kernel for image classification. In *ICIP*, pages 513–516, 2003.

[13] Z. Li, X. Zhou, and T. S. Huang. Spatial gaussian mixture model for gender recognition. In *ICIP*, pages 45–48, 2009.

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