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Automated Image Segmentation And Characterization Technique For Effective Isolation And Representation Of Human Face

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ABSTRACT
In areas such as defense and forensics, it is necessary to identify the face of the criminals from the already available database. Automated face recognition system involves face isolation, feature extraction and classification technique. Challenges in face recognition system are isolating the face effectively as it may be affected by illumination, posture and variation in skin color. Hence it is necessary to develop an effective algorithm that isolates face from the image. In this paper, advanced face isolation technique and feature extraction technique has been proposed.
Keywords - Face, Erosion, YCbCr, DCT, Eigen Values and Eigen vectors.

I. INTRODUCTION

With the computerization of defense, forensics, and surveillance departments, the paradigm has shifted to automatic face recognition system. However as it is a real time system and is affected by illumination, pose and noise, it is necessary to isolate face from the image. After isolating the face, it is necessary to extract unique features that could distinguish each face from the other. Once these features are determined, then using an appropriate classifier, face can be recognized. Though considerable research is already carried out in this area, identifying the face itself is a major challenge. In the proposed approach, an automatic face isolation system is developed using morphological operators to perform face isolation and feature extraction.

This paper is organized as follows: Section II describes the related work. Section III provides the methodology used in the proposed work. Section IV describes the results and discussion. Section V concludes the work.

II. RELATED WORK

Wadkar and Wankhade (2012) proposed the use of Haar Wavelet Transform on the test images to perform averaging and differencing process. Bi-orthogonal filters of lengths 9 and 7 and a superset of 9/7 pair is used for face recognition. Euclidean distance method is used to identify the distance between query image and the database image. The results were tested on an ORL database.

Madiafi and Bouroumi (2012) proposed a neuro fuzzy based robust face recognition system which uses Fuzzy based competitive rules for training the Kohonen Self Organizing map based classifier. A set of 200 images each of individuals where each individual is represented by a sample of 10 images is taken in the dataset in bmp format with a resolution of 180X200. The proposed approach worked well for even an untrained dataset.

M.Meenakshi (2012) used Discrete Cosine Transform (DCT) and Principal Component Analysis (PCA) for automatic face recognition. PCA includes two phases, training and testing phases where weights of each image are found and classification of one image from other is done respectively. The neural networks are trained using the features obtained from training set. Then PCA analysis is done by comparing mean image with reconstructed image.

Prasanna and Hegde (2013) proposed a method for recognizing the faces with varied pose and illumination through Active Appearance Model (AAM) and lazy classification. The proposed model comprises of two stages; developing a feature library and recognition stage. AAM is used for manual intervention in developing the feature library to extract the shape and appearance models. The recognition process includes lazy classification. This lazy classification does not require training and the proposed method was tested for various factors like accuracy, sensitivity, False Positive Rate (FPR), Positive Predictive Value (PPV), Negative Predictive Value (NPV), False Discovery Rate (FDR) and Mathew correlation coefficients. The results were better compared to conventional methods.

Tayal et.al. (2012) proposed a novel method of face recognition system based on color segmentation. Skin color and the segmentation of the skin region in a group picture are observed to be a robust cue for the face recognition and tracking systems. This method is invariant of the size of the face and its orientation. The HSV (hue, saturation and value) color model is used in the detection and the segmentation of the skin regions in a random picture. For regions classified as faces, it uses the height and width of the region to draw a rectangular box with the region's centroid as its centre. The algorithm is tested are random images taken in uncontrolled conditions and the efficiency of the face detection was found to be 73.68%.

III.   Methodology

Initially a database is created with images of 20 persons and is stored in '.jpeg' format. The spatial resolution of the images is 413X531 with 8 bits used for representing each pixel. Initially lighting compensation and skin region detection is performed. Then the following steps are involved in order to isolate the face from the image; Erosion is performed to remove the undesirable regions similar to the skin region with diamond as the structuring element of size 3. For every row, the columns with white pixels are identified and are stored in an array for identifying the face region. Also the number of white pixels in each row is counted and is stored in an array. From the gray scale image all the pixels corresponding to the above identified columns are retained, by zeroing the remaining pixels. However the neck of the person is also visible in the output image. Hence it is necessary to remove that region.

In order to perform that, the row corresponding to maximum count is identified and n rows above and below that. In order to represent the features, Eigen values are calculated and the corresponding Eigen vectors are also determined. The flowchart of the proposed work is shown in Fig.1.
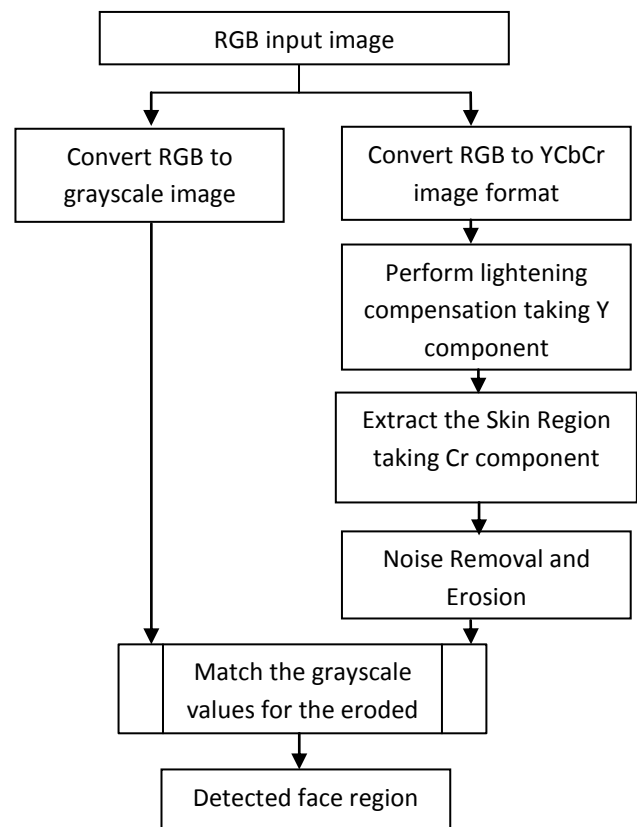

Fig.1: Flowchart for the proposed work

IV.   Results and discussion

The set of input images used in the proposed work are shown in Figure 2. These color images are then converted into grayscale images as in Figure 3. The color images are then converted to YCbCr and the luminance component is used to perform lighting compensation which is represented in Figure 4. Skin region is found by taking the chrominance component values the corresponding output images are shown in Figure 5. Unwanted noise elements are removed and the corresponding output images are shown in Figures 6 and 7 respectively. Corresponding face images are shown in Figure 8 and the final output images without neck region are shown in Figure 9. Features extracted from the isolated images by determining the Eigen values. Mean and standard deviation are calculated for approximation, horizontal and vertical co-efficients are tabulated in Table 1. From table 1 it is clear that every face has a unique Eigen value.

Fig.2: RGB color images

Fig.3: Grayscale image
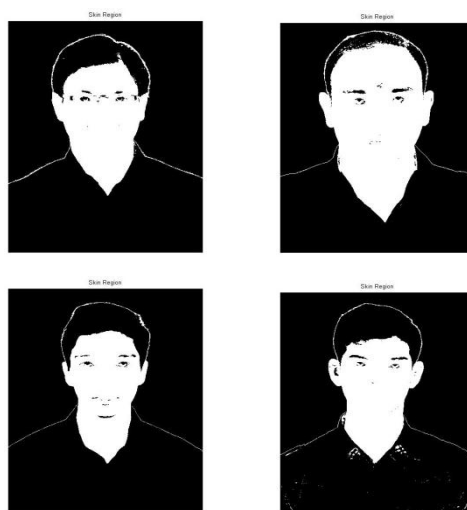
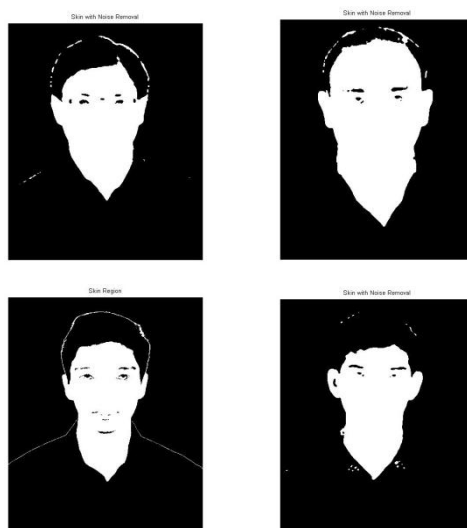

Fig.4: Lighting Compensation

Fig.5: Skin Region

Fig.6: Noise Removed from the skin region
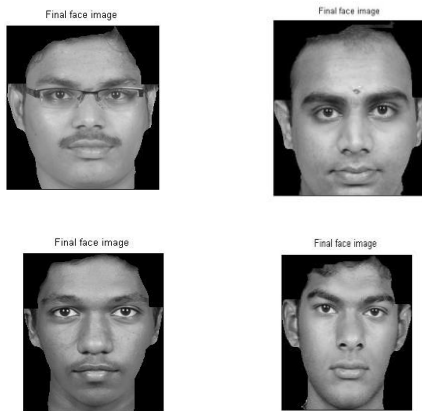

Fig.7: Performing Erosion

Fig.8: Face Region

Fig.9: Final face image

Table 1: Eigen values and statistical parameters for face image

Image	Max. Eigen value	Approximation coefficients		Horizontal coefficients		Vertical coefficients	
		Mean	Std.	Mean	Std.	Mean	Std.
1	92.67	0.800	0.086	0.0017	0.016	0.0004	0.026
2	111.9	0.082	0.063	-0.0015	0.012	0.0004	0.025
3	74.81	0.692	0.076	-0.0014	0.011	-0.0006	0.019
4	84.19	0.746	0.002	0.0020	0.018	0.0001	0.023

V.   Conclusion

In this paper an effective image processing based technique for detecting face from the input image has been proposed successfully. It works well on all the test images irrespective of skin color and background. However the proposed technique involves morphological image processing operators which indeed are dependent on the shape and size of the structuring element. Also in certain cases a small portion of the neck region is present. Hence in future the algorithm has to be modified so that the neck region is removed. This paper ends with describing the face image using Eigen values. In future face recognition system has to be developed with Eigen values and other descriptors as input parameters.

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