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Face Recognition from Group Photograph

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Abstract:-Face recognition systems are progressively becoming popular as means of extracting biometric information. Face recognition has a critical role in biometric systems and is attractive for numerous applications including visual surveillance and security. Because of the general public acceptance of face images on various documents, face recognition has a great potential to become the next generation biometric technology of choice. Face images are also the only biometric information available in some legacy databases and international terrorist watch-lists and can be acquired even without subjects' cooperation. Many photographs include multiple individuals. There is a strong requirement to identify faces in these photographs automatically. Proposed face recognition systems recognize individuals from the group photograph containing multiple people. This problem is commonly referred to as face location, face extraction, or face segmentation. This paper presents an interactive algorithm to automatically segment out and recognize a person's face from a group photograph. The method involves a fast, reliable, and effective algorithm that exploits the spatial distribution characteristics of human skin color.

Index Terms: **Color Spaces, Face Recognition, Face Segmentation.**

I. INTRODUCTION

With the advent of inexpensive digital cameras and social networking sites such as Facebook, millions of personal photographs are uploaded daily. Many photographs include multiple individuals. There is a strong desire to identify and tag faces in these photographs - automatically and accurately. And, unlike access control systems which typically include images with a single person, video surveillance images commonly include multiple people and even crowds. These scenarios require face recognition systems to identify multiple individuals in a single image and they have to be effective in unconstrained imaging conditions. There has been a great deal of progress in recognizing people over pose and lighting variation. While these techniques seem reasonable for photographs containing single individuals, there is an opportunity to exploit the common imaging conditions across individuals in the same photograph. Face recognition presents a challenging problem in the field of image analysis and computer vision, and as such has received a great deal of attention over the last few years because of its many applications in various domains.

II. ADVANTAGE OF USING FACE FOR RECOGNITION

Biometric-based techniques are promising option for recognizing individuals in recent years. Biometric-based technologies include identification based on physiological characteristics (such as face, fingerprints, finger geometry, hand geometry, hand veins, palm, iris, retina, ear and voice) and behavioural traits (such as gait, signature and keystroke dynamics). Face Recognition appears to offer several advantages over the above mentioned methods, a few of which are outlined here:

a. Almost all these technologies require some voluntary action by the user, i.e., the user needs to place his hand on a hand-rest for fingerprinting or hand geometry detection and has to stand in a fixed position in front of a camera for iris or retina identification. However, face recognition can be done without any explicit action or participation on the part of the user since face images can be acquired from a distance by a camera. This is particularly beneficial for security and surveillance purposes.

b. Data acquisition in general is drawback with problems for other biometrics techniques that rely on hands and fingers can be rendered useless if the epidermis tissue is damaged in some way . Iris and retina identification require expensive equipment and are much too sensitive to any body motion. Voice recognition is susceptible to background noises in public places. However, facial images can be easily obtained with a couple of inexpensive fixed cameras. Good face recognition algorithms and appropriate pre-processing of the images can compensate for noise and slight variations in orientation, scale and illumination.

c. Finally, technologies that require multiple individuals to use the same equipment to capture their biological characteristics potentially expose the user to the transmission of germs and impurities from other users .However, face recognition is totally non-intrusive and does not carry any such health risks.

III. APPLICATIONS OF FACE RECOGNITION

There are numerous application areas and specific application in which face recognition can be used are listed below.

- Information Security: Access security (OS, data bases) , Data privacy (e.g. medical records), User authentication (trading, on line banking)
- Access Management: Secure access authentication (restricted facilities), Permission based systems, Access log or audit trails
- Biometrics: Person identification (national IDs, Passports, voter registrations, driver licenses), Automated identity verification (border controls)
- Law Enforcement: Video surveillance, Suspect identification, Suspect tracking (investigation), Simulated aging, Forensic Reconstruction of faces from remains
- Personal security: Home video surveillance systems, Expression interpretation (driver monitoring system)
- Entertainment - Leisure Home video game systems, Photo camera applications

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IV. PROBLEM DEFINITION

The face recognition problem can be formulated as follows: Given an input group photograph (still image) having multiple face image and a database of face images of known individuals, then determine or recognise the identity of the persons present in the group photograph

V. PROPOSED ALGORITHM FOR FACE RECOGNITION

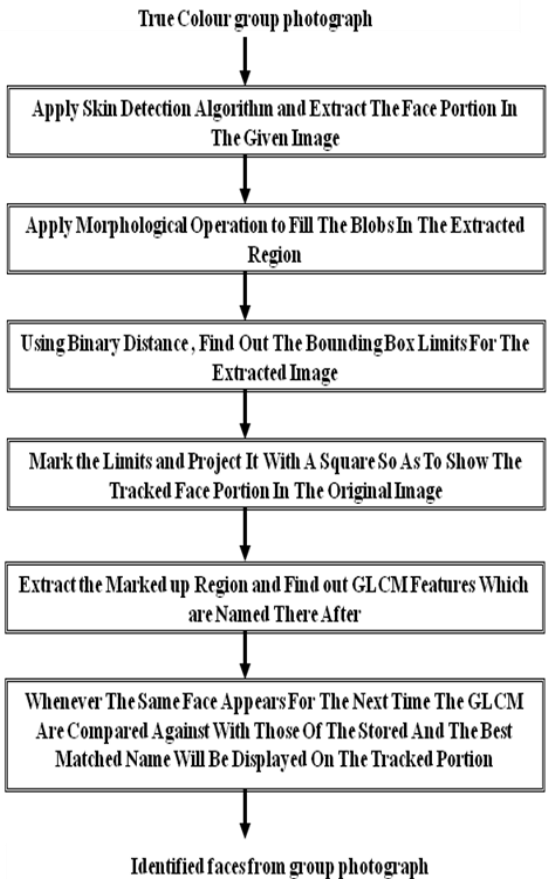

Fig 1. Proposed Algorithm for Face Recognition

The solution to the problem involves segmentation of faces (face detection) from cluttered scenes, feature extraction from the face regions, recognition, or verification. In identification problems, the input to the system is an unknown face, and the system reports back the determined identity from a database of known individuals, whereas in verification problems, the system needs to confirm or reject the claimed identity of the input face. Automatic face recognition consists of subtasks in a sequential manner face detection, face segmentation, normalization and face recognition, verification. Fig 1 shows algorithm for face recognition for still group photograph

A. Input images:

Input image set composed of color images obtained from the Internet, covering a wide range of variations. Photograph having multiple faces of any resolution are given as a input to the algorithm. Fig.2 is group photographs example which will given as a input to the algorithm

Fig 2:

B. Skin Detection Algorithm for face detection:

Face detection is a computer technology that determines the location and size face in arbitrary (digital) image. There are different approaches to face detection. They include both the easy approach and the difficult approach. Below there is a list of most common approaches to face detection.

i) Finding faces in image with controlled background

This is the easiest way out and easy of all the approaches. In this approach, images are used with a plain mono color background, or images with a predefined static background. As removing the background gives the face boundaries.

ii) Finding faces by color

This is the approach where face is detected using skin color. Once we have access to color images it is possible to use the typical skin color to find face segments. But in this approach, there is a drawback. Skin color varies from race to race and this does not work well with all kind is skin color. In addition, this approach is not very robust under varying lighting conditions.

iii) Finding faces by motion

By using a real time video it is possible to find face, the face that is always in motion in reality. And in this process a real time video is used to find face. But there is a drawback to this process. Problem arises when other objects are moving in the background.

iv) Finding faces in unconstrained scenes

This approach is the most complicated approach of all and this approach tops all the other approaches. In this approach, face has to be detected from a black and white still image.

v) Geometry Based

These methods utilize geometrical information of face region. It represents face using shapes like ellipse. It cannot handle large intensity variations, occlusion and noise.

vi) Appearance Based

Gray values are the most important parameter for the face detection. Face detection performance is affected by light intensity and occlusions.

vii) Edge Based

The edge information is extracted and used to detect face. These methods can handle large variations of the face images but requires pre-processing for illumination normalization.

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The method described here is skin color based face detection. It requires fewer calculations and robust to pose and scale variation. The method is described below.

Color Analysis:

The use of color information has been introduced to the face-locating problem in recent years, and it has gained increasing attention since then. The color information is typically used for region rather than edge segmentation. We classify the region segmentation into two general approaches, as illustrated in Fig. 3. One approach is to employ color as a feature for partitioning an image into a set of homogeneous regions. For instance, the color component of the image can be used in the region growing technique. The other approach, however, makes use of color as a feature for identifying a specific object in an image. In this case, the skin color can be used to identify the human face. This is feasible because human faces have a special color distribution that differs significantly (although not entirely) from those of the background objects. Hence this approach requires a color map that models the skin-color distribution characteristics. The Fig 4. Also shows a white contour highlighting the facial region. The histograms of the color information (i.e., Cr and Cb values) bounded within this contour are obtained as shown in Fig. 5. The diagrams show that the chrominance values in the facial region are narrowly distributed, which implies that the skin color is fairly uniform. Therefore, this individual color feature can simply be defined by the presence of Cr values within, say, 136 and 156, and Cb values within 110 and 123.

Using these ranges of values, we managed to locate the subject's face in another frame of *Foreman* and also in a different scene (a standard test image called *Carphone*), as can be seen in Fig 5. This approach was suggested in the past by Li and Forchheimer; however, a detailed procedure on the modeling of individual color features and their choice of color space was not disclosed. In another approach, the skin-color map can be designed by adopting histograming technique on a given set of training data and subsequently used as a reference for any human face. Such a method was successfully adopted by the authors,, Sobottka and Pitas, and Cornall and Pang.

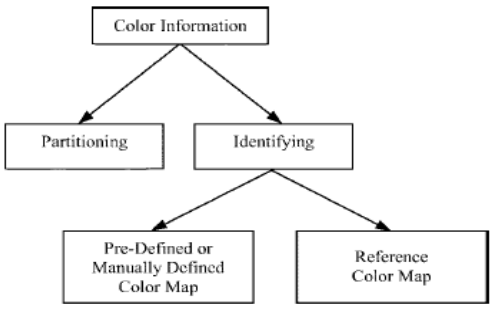

Fig.3. the Use of Color Information for Region Segmentation.

Among the two approaches, the first is likely to produce better segmentation results in terms of reliability and accuracy by virtue of using a precise map. However, it is realized at the expense of having a face-segmentation process either that is too restrictive because it uses a predefined map or requires human interaction to manually define the necessary map.

Fig.4. Foreman Image with a White Contour Highlighting the Facial Region.

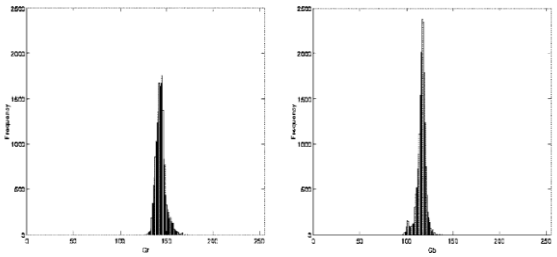

Fig. 5. Histograms of Cr and CB components in the facial region.

Therefore the second approach is more practical and appealing, as it attempts to cater to all personal color features in an automatic manner, albeit in a less precise way.

Color Space:

An image can be presented in a number of different color space models.

RGB:

This stands for the three primary colors: red, green, and blue. It is a hardware-oriented model and is well known for its color-monitor display purpose.

HSV:

An acronym for hue-saturation-value. *Hue* is a color attribute that describes a pure color, while *saturation* defines the relative purity or the amount of white light mixed with a *hue; value* refers to the brightness of the image. This model is commonly used for image analysis. Conversion from RGB to HSV is done using following equations

$$H_1 = \cos^{-1}\frac{0.5[(R-G)+(R-B)]}{\sqrt{(R-G)^2+(R-B)(G-B)}} \quad (1)$$

$$H = H_1 \quad if \quad B \le G \quad H = 360^0 - H_1 \quad if \quad B > G \quad (2)$$

$$S = \frac{Max(R,G,B)-Min(R,G,B)}{Max(R,G,B)} \quad (3)$$

$$V = \frac{Max(R,G,B)}{255} \quad (4)$$

.YCbCr Model

The mostly used color space is YCbCr where Y is luminance component, Cb is blue chrominance and Cris red

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chrominance. The chroma component is represented only by blue and red as the sum of chromavalue of red, green and blue component is always constant. The separate luma and chroma component makes this model illumination invariant. The conversion from RGB to YCbCr is done using following equations:

$$Y = 0.299R + 0.587G + 0.114B \quad (5)$$

$$C_b = 128 (0.169R\ 0.331G\ 0.5B) \quad (6)$$

$$C_r = 128\ (0.5R\ 0.419G\ 0.081B) \quad (7)$$

Experimental results show that skin pixel has Cr value about 100 and Cb value about 150. Pixel is classified asskin or non-skin pixel using Eq. (8).

$$(R,G,B) = \begin{cases} 255 & if\ C_r \in [80,120] and\ C_b \in [133,165] \\ 0 & if\ C_r \notin [80,120] or\ C_b \notin [133,165] \end{cases} \quad (8)$$

Limitations of Color Segmentation

A simple region segmentation based on the skin-color map can provide accurate and reliable result if there is a good contrast between skin color and those of the background objects. However, if the color characteristic of the background is similar to that of the skin, then pinpointing the exact face location is more difficult, as there will be more falsely detected background regions with skin-color appearance. Note that in the context of face segmentation, other parts of the body are also considered as background objects. There are a number of methods to discriminate between the face and the background objects, including the use of other cues such as motion and shape. Provided that the temporal information is available and there is *a priori* knowledge of a stationary background and no camera motion, motion analysis can be incorporated into the face-localization system to identify nonmoving skin-color regions as background objects. Alternatively, shape analysis involving ellipse fitting can also be employed to identify the facial region from among the detected skin-color regions. It is a common observation that the appearance of a human face resembles an oval shape, and therefore it can be approximated by an ellipse . In this paper, however, we propose a set of regularization processes that are based on the spatial distribution and the corresponding luminance values of the detected skin-color pixels. This approach overcomes the restriction of motion analysis and avoids the extensive computation of the ellipse-fitting method. The details will be discussed in the next section along with our proposed method for face segmentation. In addition to poor color contrast, there are other limitations of color segmentation when an input image is taken in some particular lighting conditions. The color process will encounter some difficulty when the input image has:

• a “bright spot” on the subject’s face due to reflection of intense lighting a dark shadow on the face as a result of the use of strong directional lighting that has partially blackened the facial region;

• been captured with the use of color filters. Note that these types of images are posing great technical challenges not only to the color segmentation approach but also to a wide range of other face segmentation approaches, especially those that utilize edge image, intensity image, or facial feature-points extraction. However, we have found that the color analysis approach is immune to moderate illumination changes and shading resulting from a slightly unbalanced light source, as these conditions do not alter the chrominance characteristics of the skin-color model.

C. Apply Morphological Operation to Fill The Blobs

This is used as a image processing tools for sharpening the regions and filling the gaps for image. The dilation operator is used for filling the broken gaps at the edges and to have continuities at the boundaries. A structuring element of square matrix is used to perform dilation operation. Then using Binary distance , find out the bounding box limits for the extracted image. After that mark the limits and project it with a square so as to show the tracked face portion in the original.

D. GRAY LEVEL CO-OCCURANCES MATRIX for Face Recognition

After extracting faces from group photograph next is to do face recognition. For that from the detected faces feature are extracted which gives the properties of the faces, which can be used for training in the database. The obtained trained feature is compared with the test sample feature obtained of the database to recognize the face . Texture features or more precisely, Gray Level Co-occurrence Matrix (GLCM) features are used to recognize the face from group photograph. Five co-occurrence matrices are constructed in four spatial orientations horizontal, right diagonal, vertical and left diagonal (0°, 45°, 90°, and 135°). A fifth matrix is constructed as the mean of the preceding four matrices.

VI. CONCLUSION

Face recognition is a challenging problem in the field of image analysis and computer vision that has received a great deal of attention over the last few years because of its many applications in various domains. Research has been conducted vigorously in this area for the past four decades or so, and though huge progress has been made, encouraging results have been obtained and current face recognition systems have reached a certain degree of maturity when operating under constrained conditions; however, they are far from achieving the ideal of being able to perform adequately in all the various situations that are commonly encountered by applications utilizing these techniques in practical life

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