

Review of Face Detection and Recognition Techniques

Ravinder Pal Singh¹, DaljitKaur²

Mtech¹, Assistant Prof², Department of Information Technology,
Chandigarh Engineering College, Landran (Mohali)

Papnejarps@gmail.com¹, Er.daljitkaur@gmail.com²

9878274198

Abstract— Face detection is the first basic component of any face processing system. In the last few years, Researchers have shown keen interest in this active research area such as Face Detection and recognition system. Face recognition system is used to recognize person by employing only the image. Face detection technique is used to detect human face and extract the region of interest. The next step is to process the region of interest by using face recognition techniques. This paper presents a brief review of the techniques used for face detection and recognitions.

Keywords— Face Detection, Face Recognition, Artificial Neural Network (ANN), Viola-Jones algorithm, Skin color model.,F.D.R.

INTRODUCTION

In this age of information Technology, there is a growing need to keep the Secrecy and security of information. Many cases of identity thefts have been reported in banks and computers. Uses of PIN, Keys, and Passwords have often failed to check frauds. To beef up security of information, a new technology “Biometrics” has come up [1]. This technology uses methods to recognize each unique human being based on some physical or behavioral features. Face Recognition is the emerged and fastest biometric technology. Face Recognition can solve this problem because each face has unique characteristics of person.

Face Matching is the most significant and difficult process in face recognition. Face matching is crucial to achieve powerful face matching under different conditions such as lighting variation, face expression variation and angle variations etc. to match facial database.[2]

I: GENERAL BLOCK DIAGRAM OF FACE RECOGNITION

There are three steps to apply procedure of face detection and recognition of system.

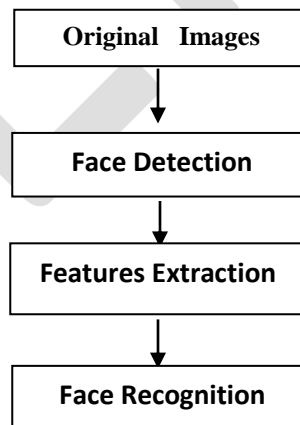


Figure 1: Face Recognition of System.

This figure is divided into three rectangular boxes Face Detection, Features Extraction and Face Recognition.

The main Purpose/Task of Face Detection Box is to find

- (1). Whether human faces appear in a user input images
- (2) where these faces are located at. [3]

The Second step of this System is features Extraction in which Facial features are extracted Such as skin color of person, eye's color of person, size of the nose(height, width), gaps between the two eyes , size of the lips, measures gap between the nose and the lips and width of chins.[3]

The next and third step of this process is Face Recognition Box. Face recognition can be done by comparing extracted features from given input image to facial database Extracted Feature by Artificial Neural network (ANN) or Holistic method.

II. Face Detection Techniques

There are several face detection techniques available now-a-days. The novel face detection techniques are based upon scene recognition, color recognition, appearance based models, etc. The following are the details of the face detection techniques available to us:

II.1 Detecting faces in the images with mono-color (controlled) background:

To find the face in the controlled background is always the easiest method. Such method utilizes the color or appearance based filtering in order to recognize the face area. Such mono-color image does not contain any background noise which becomes the overburdened process to recognize the face region. In this type of detection, the edge marking and edge based extraction becomes the most popular process to be used with.

II.2 Detecting faces by color:

In the colored image, the face detection can also be performed on the basis of color. The skin color model can be used to fetch the face region from the image. There are several color spaces available, and for each color space there is different range defined for the face region detection. The color based detection follows the following points in general:

- A. Explanation of basic color extraction for face detection
- B. Face detection(F.D) in color images
- C. F.D in color images using PCA[4]
- D. F.D.R in color images with a complex background
- E. Computer Vision and Human Skin Color

II.3 Finding faces by motion:

In the case of video capturing, the face detection process must evaluate the video frames individually and in the correlation model in order to know the face region. The motion based face detection process becomes complex because there is the need to continuous frame extraction and frame evaluation by using a few image processing techniques in order to detect the face region. This means the face region detection algorithm in the motion (video) must be as quickest as possible in order to minimize the delay. The following are the essential steps required to detect the face in motion:

1. Explanation of basic motion detection for face finding
2. Person eyes are simultaneously blinking. Blink detection can be used to search and normalize faces[4]

II.4 Hybrid Algorithms

The combination of several good approaches can create the robust combination for face detection. The combination of the techniques is generally composed in the layered approach models, where one technique passes its output to other for further evaluation. The next level algorithm finally returns the final result about the face region.

1. The combination of appearance based models, color based models and 3D face detection models
2. The combination of appearance based models, background estimation and removal and edge detection techniques.

II.5 Skin color model for Face Detection

Skin color model is used for to detect skin region of various images. Skin model have been divided into 3 model such as RGB color space, YCbCr color model, HSV color model.[12]

1. RGB color space:

This color model has all colors which can be got by using three primary colors namely Red, Blue, Green. It is in the form of a three dimensional cube with three primary colors.[5] Majority of computer graphics make use of this. Because this color model is light sensitive and the three colors being strongly correlated, this color model is found wanting in many image processing algorithms.[12]

In this color space, skin color is detected based on the following conditions:

(1) For uniform daylight illumination:

$R > 95$, $G > 40$, $B > 20$, $R > G$ and $R > B$.[5]

(2) Under flashlight or daylight called lateral illumination:

$R > 20$, $G > 210$, $B > 170$, $|R - G| < 15$, $R > G$ and $G > B$. [5]

(2) YCbCr color space:

Digital video information is mainly represented by Ycbr color space. In this color model, a color is represented by brightness as well as two color difference signals. Y is the brightness component. It is computed as the weighted sum of value of RGB. Cb is computed by subtracting a reference value from the red component.[5] .Likewise Cr is computed by subtracting a reference value from the red component.[5]

"rgb2ycbcr" and "ycbcr2rgb" are MATLAB function for the transformation used during implementation [5].

(3) HSV Color Space:

The HSV color space is founded on three color components. The color defining component is H, the hue component. The Second component is called the saturation component S and it defines how pure the color is. The third component is Value component V which specifies intensity. This color space is a three dimensional hexacone. The values of H vary from 0 to 1 on a circular scale. The values of S also vary from 0 to 1. 100% color purity is represented by 1. Likewise values of V change from 0 to 1.

.rgb2hsv" and "hsv2rgb" are MATLAB function for the transformation used during implementation.

II.6 Viola & Jones - Face Detection

The revolution in face detection came with Viloa & Jones in 2001. This algorithm is implemented in OpenCV. This algorithm has four stages:

- a. Harr Features selection.
- b. Creating integral Image.
- c. Adaboost Training algorithm.
- d. Cascaded classifiers.[courtesy: Wikipedia.org]

By the use of a cascade of "weak Classifiers", and simple Haar features splendid results can be obtained. Now a days, this algorithm is mainly used. There are a number of reasons for using features instead of the pixels directly. The first reason is that features can act to encode ad-hoc domain knowledge which is not easy to learn with a limited quantity of training data. The second reason is that features based system operates at a much faster speed. To be more specific three types of features are used. The difference between the sum of pixels in the shaded rectangle and sum of pixels in the unshaded rectangle is the value of two rectanglefeature.(figure (a),(b))

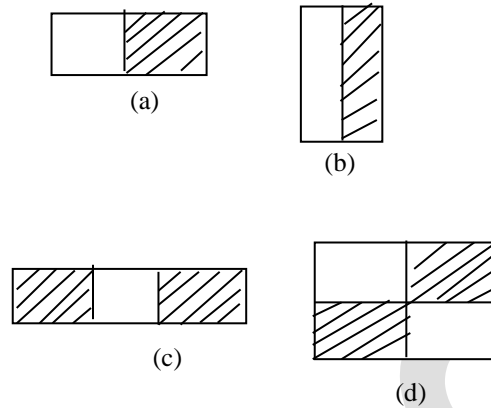


Figure 2: Feature types of Viola and Jones

The difference between the sum of pixels in the central rectangle and the sum of pixels within two shaded rectangles is the value of a three rectangle feature (figure(c)). The value of four – rectangles feature is computed by the difference between diagonal pairs of rectangles (figure (d)).

III. FACE RECOGNITION AND IMAGE RETREIVAL TECHNIQUES

With exception of identical twins, the chances of having two persons with exactly similar faces are very remote. Therefore a person's face can be used in the biometric identity based systems. It can be used in conjunction with the Pin or smart card.

The extant face recognition algorithms use several types of face recognition methods. Some of these are knowledge –based, appearance based, feature invariant, template based methods [7][8][10]

1. Knowledge based methods:

Knowledge based methods describe a given face on the basis of rules .But these rules at times not clearly defined.[8]

2. Appearances based methods:

Appearances based methods make use of many examples of images of faces as well as facial features.[8][10]

3. Features invariant method:

Features invariant method uses features like nose , mouth, eyes lips, skin color to detect a face .But these features can get corrupted by pose , [illumination](#) etc.[7]

4. Template matching method:

In template matching methods the input images are compared with the standard patterns of a face However variation of shape or pose offer problem and are difficult to deal with. Template matching is a technique for searching small portions of an image which match a template image.[10] It is used to find the more accurate faces in case of face recognition. There are many cross correlation methods used for the template matching.

III.1 Feature based Recognition

In feature based like eye, nose month are extracted. Therefore the geometrical relationship existing in these is computed. Then the standard pattern recognition techniques are used to compare faces.[8][9]

III.2. Holistic Approach

Holistic Approach endeavors to recognize faces using descriptions based on the whole image rather than on local features.[9] Its two subdivisions are statistical approach and AI approach.

III.2.1 Statistical

In Statistical approach, a 2D array of intensity values represents the face the input face is compared with the images in the database and recognized.[8]

III.2.2 AI approach:

AI approach makes use of machine learning techniques and neural networks for face recognition.[8]

III.3 Hybrids methods:

In this of face recognition Systems both the features based methods and holistic methods are used .in hybrids methods are used. In hybrids methods 3-D images are normally used. The face is captured by scanning a photograph Then its location and size are determined .A template is made and then converted into a code. Lastly the received data is compared with database.[9]

III.4 Other techniques (PCA, LDA, MPCA):

4.1. Principal component Analysis (PCA):

It involves a mathematical Procedure variables are changed into uncorrelated ones. These are called Principal components. Orthogonal transformation relates these components to original variables.[7][11]

4.2. Multi-linear Principal component Analysis (MPCA):

Multi-linear Principal component Analysis is a modification of PCA. It uses multi-linear algebra. While PCA uses only one vector, in MPCA a no of transformation vectors are used.[7]

4.3. Linear Discriminants Analysis (LDA):

Linear Discriminants Analysis helps in evaluating the importance of varied facial features in relation to their discriminant power. [7][11]

IV. CONCLUSION

This paper explains various techniques of face detection and recognition at various conditions such as angle variation, face expression, position, and various lighting conditions. This paper also describes hybrid method of face detection and recognition. In future, a new hybrid algorithm can be developed using existing techniques of detection and face recognition.

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