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Intelligent Face Recognition

Akram Qureshi[1*] and Ashok Kajla[2]

[1*,2]RTU Kota Rajasthan India

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***Abstract*—** Face recognition has been an important and hard problem in computer vision application. Recently, haar cascade method has proven to be an effective method for face recognition. In this thesis, a simple and powerful approach is developed for real time multi face recognition system. A threefold stage application is developed. in the first stage face detection is done by using Haar cascade. In second stage, Haar cascade features are stored in the memory and compare with the data base faces. In third stage the matched database face is recognized for the query face and displayed with recognized face name. The three stages are mentioned as face detection, feature extraction storage & comparison and at last face recognition. The experimental results for real time multiple recognition system is shown and elaborates the benefit of using the described approach.

***Keywords*—** Face detection, Face recognition, Feature extraction, Haar cascade.

I. INTRODUCTION

Face recognition is a technique which is used to identify a particular person in a digital image by analyzing and comparing pattern. In other word we can say Face recognition system is a different kind of computer application. This is automated software to identifying or verifying a person from a digital image or a video frame from video source.

In Face recognition face image is used as a input through camera and can be classified in to two part one is static and another is dynamic. Face recognition systems recognizing a human face from scene and extract it. the system measures overall facial structure, distances between eyes , mouth and jaw edge , than compares these nodal points to the nodal points computed from a data base of pictures in order to find a match.

Face recognition system is a very useful system because of quality. It has an accuracy and errorless over the other security systems. Face recognition system is advance system over other biometric methods. Face recognition systems are commonly used for security purpose. But this system is spreading all over the world in many other applications.

Many companies and industries or persons use many security systems. That systems require Passwords, PIN code, tokens, cards. Password or pin code can be forgotten and it is difficult to remember all time. Card or many things such as token keys etc can be misplaced. So to minimize these problems we use biometric based technologies. There are different types of biometric based technologies.

However, an individual's biological traits cannot be misplaced, forgotten, stolen or forged. 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 behavioral traits (such as gait, signature and keystroke dynamics).face recognition is also a biometric method.

Face recognition has many advantages over some other biometric methods. These biometric technologies require fixed position in front of the camera for retina identification, for finger printing user needs to put hand on a hand rest. But by face recognition system a face images can be acquired from a distance by camera. Face recognition system is beneficial for security and surveillance purposes. In other biometric system a fingerprint security system can be risky or useless whether an epidermis tissue is damaged in some way. In other biometric system signature can be forged or modified. Voice recognition is susceptible to background noises in public places and auditory fluctuations on a phone line or tape recording. But with face recognition system face images can be obtained easily with fixed cameras. face recognition is totally non-intrusive and does not carry any such health risks. So this is the reason to make the face recognition system. I have work done on the face recognition system.

This system is a combination of two techniques first is face detection and another is recognition. The face detection is performed on live acquired images. I have used Haar Cascading in face detection. Then face is detected and after that I used face recognition algorithm used to recognize the face.

2. Problem faced by researcher in face identification and recognition

Main problem of this paper is to design and implement a face recognition system. The system should detect faces in live acquired images in front of the camera, and detected faces should be recognized by recognition algorithm. This system will be very useful in security system. This paper

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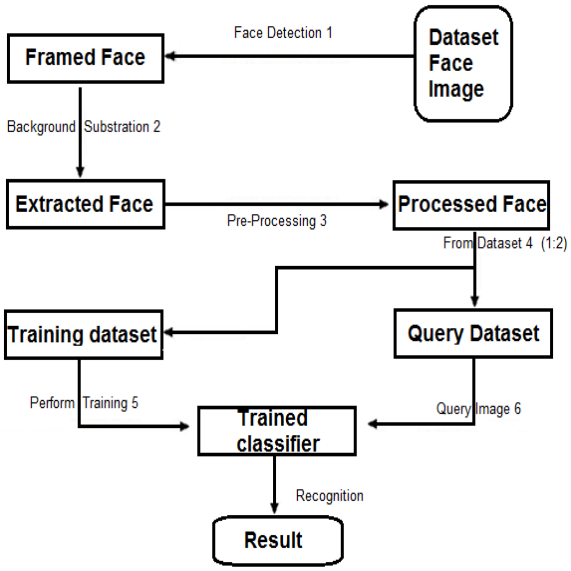
will be part of security system. I hope people will use this very much in future.
Face recognition system will detect, extract and recognize frontal faces from acquired live images.
System should work under changing lighting conditions in the laboratory.
System should not extract faces if they use sunglasses. It means face should be without spectacle or without sunglasses.

3. Proposed methodology for face recognition

Face recognition system is divided into three parts.
1. Detection
2. Recognition
3. Detection & Recognition
In face recognition, face detection is the first step. It is very difficult to detect the face because there are combinations of many algorithms for face detection to increase accuracy and errorless.

There are two methods of face detection.
1. Knowledge-Based Methods
2. Image-Based Methods
Knowledge-Based methods use information about facial features, template matching or skin color. Skin color is modeled in each color spaces like RGB (Red-Green-Blue), HSV (Hue- Saturation-Value), YUV (Luminance-Blue Luminance Difference-Red Luminance Difference). YCbCr (Luminance-Blue Difference Chroma-Red Difference Chroma), and in statistical models.
Facial features are important information for human faces and standard images can be generated using these information. Facial Features are used to find nose, eyes, mouth, or other facial features to detect the human faces. Face has a unique thing to differentiate from other objects and hence a template can be generated to scan and detect faces. To detect faces and facial features by extraction of skin like region with YCbCr color space and edges are detected in the skin like region. Then, eyes are found with Principal Component Analysis (PCA) on the edged region. Finally, Mouth is found based on geometrical information. To find eyes, eyebrows and mouth, color snakes are applied to verified face image. Ruan and Yin segment skin regions in YCbCr color space and faces are verified with Linear Support Vector Machine (SVM). For final verification of face, eyes and mouth are found with the information of Cb and Cr difference. For eye region Cb value is greater than Cr value and for mouth region Cr value is greater than Cb value.



"Figure: 1 Flow Chart"

I have worked on visual studio. i installed emgu cv. I have used **c#** language with the help of emgu library on visual studio. Perception is the first step to make this face recognition system.

1 Perception:

First I have installed the camera connected to computer. After that I have used picture box and buttons from toolbox. After that I have coded the programme for camera capture.

2 Feature extraction:

I have used Haar Cascade to extract the feature. this is a Viola and Jones method called Haar Cascade. The human face is a dynamic object that comes in many forms and colors. Facial recognition is not possible if the face is not isolated from the background. An image is only a collection of color and/or light intensity values. Analyzing these pixels for face detection is time consuming and difficult to accomplish because of the wide variations of shape and pigmentation within a human face. Pixels often require reanalysis for scaling and precision. Viola and Jones devised an algorithm, called Haar Classifiers, to rapidly detect any object, including human faces, using AdaBoost classifier cascades that are based on Haar-like features and not pixels.

Haar cascade

Haar like features use the change in contrast values between adjacent rectangular groups of pixels. The contrast variances between the pixel groups are used to determine

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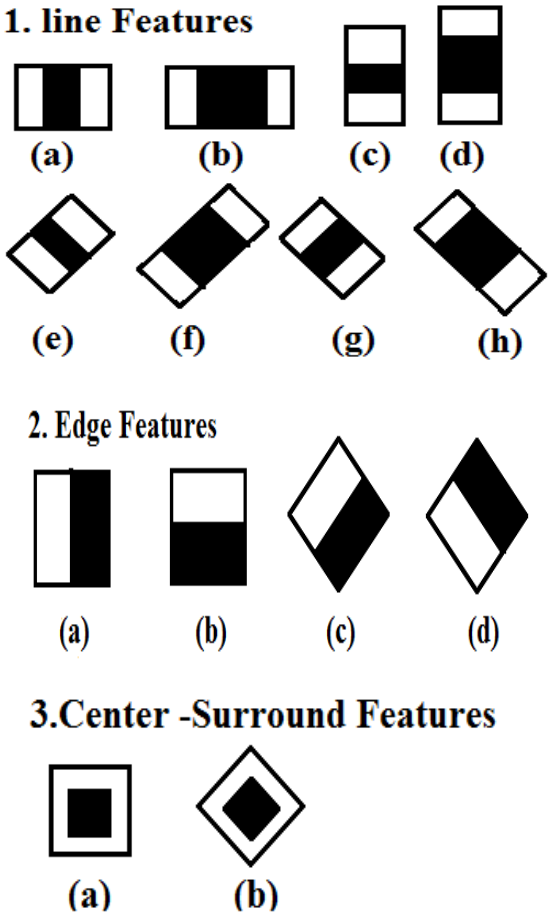
relative light and dark areas. Two or three adjacent groups with a relative contrast variance form a Haar-like feature. Haar-like features, as shown in Figure 2 are used to detect an image . Haar features can easily be scaled by increasing or decreasing the size of the pixel group being examined. This allows features to be used to detect objects of various sizes.



"Figure 2: Common Haar Features"

Lienhart and Maydt introduced the concept of a tilted (45°) Haar-like feature. This was used to increase the dimensionaly of the set of features in an attempt to improve the detection of objects in images. This was successful, as some of these features are able to describe the object in a better way. For example, a 2-rectangle tilted Haar-like feature can indicate the existence of an edge at 45°.

Messom and Barczak extended the idea to a generic rotated Haar-like feature. Although the idea sounds mathematically sound, practical problems prevented the use of Haar-like features at any angle. In order to be fast, detection algorithms use low resolution images, causing rounding errors. For this reason, rotated Haar-like features are not commonly used.

The simple rectangular features of an image are calculated using an intermediate representation of an image, called the integral image. The integral image is an array containing the sums of the pixels' intensity values located directly to the left of a pixel and directly above the pixel at location (x ,y) inclusive. So if A[x ,y] is the original image and AI[x ,y] is the integral image then the integral image is computed as shown in equation 1 and illustrated in Figure 3.

$$AI[x, y] = \sum_{x' \le x,\ y' \le y} A(x', y') \qquad (1)$$

The features rotated by forty-five degrees, like the line feature shown in Figure 2(e), as introduced by Lienhart and Maydt, require another intermediate representation called the rotated integral image or rotated sum auxiliary image [5]. The rotated integral image is calculated by finding the sum of the pixels' intensity values that are located at a forty five degree angle to the left and above for the x value and below for the y value. So if A[x, y] is the original image and AR[x, y] is the rotated integral image then the integral image is computed as shown in equation 2 an illustrated in Figure 4.

$$AR[x, y] = \sum_{x' \le x,\ x' \le x - |y - y'|} A(x', y') \qquad (2)$$

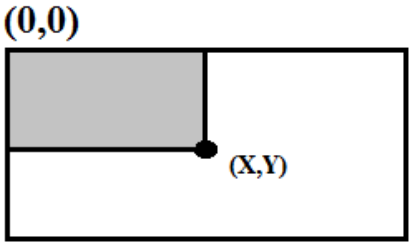


Figure 3 summed area of integral image

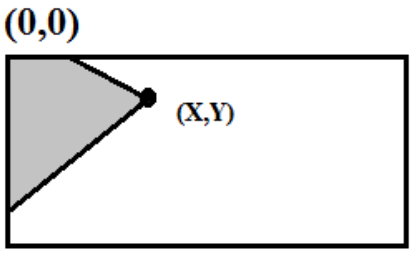


Figure 4 summed area of rotated integral image

It only takes two passes to compute both integral image arrays, one for each array. Using the appropriate integral image and taking the difference between six to eight array elements forming two or three connected rectangles, a feature of any scale can be computed. Thus calculating a feature is extremely fast and efficient. It also means

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calculating features of various sizes requires the same effort as a feature of only two or three pixels. The detection of various sizes of the same object requires the same amount of effort and time as objects of similar sizes since scaling requires no additional effort.

Fast computation of Haar-like features

One of the contributions of Viola and Jones was to use summed area table, which they called integral image. Integral images can be defined as two-dimensional lookup table in the form of a matrix with the same size of the original image. Each element of the integral image contains the sum of all pixels located on the up-left region of the original image (in relation to the element's position). This allows to compute sum of rectangular areas in the image, at any position or scale, using only four lookups:

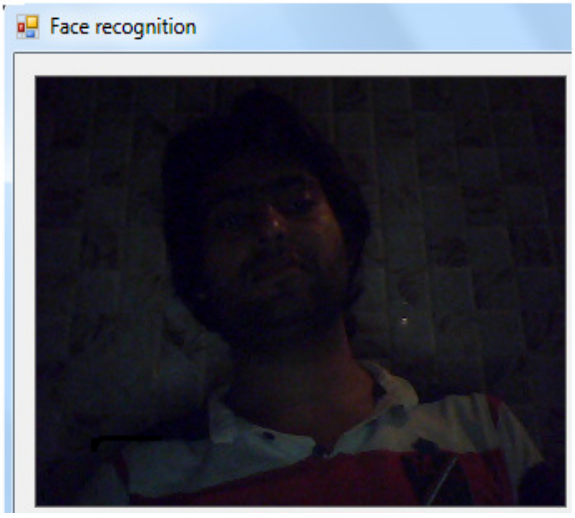
$$\mathrm{sum} = I(C) + I(A) - I(B) - I(D).$$

where points A, B, C, D belong to the integral image I, as shown in the figure.

Each Haar-like feature may need more than four lookups, depending on how it was defined. Viola and Jones's 2-rectangle features need six lookups, 3-rectangle features need eight lookups, and 4-rectangle features need nine lookups.

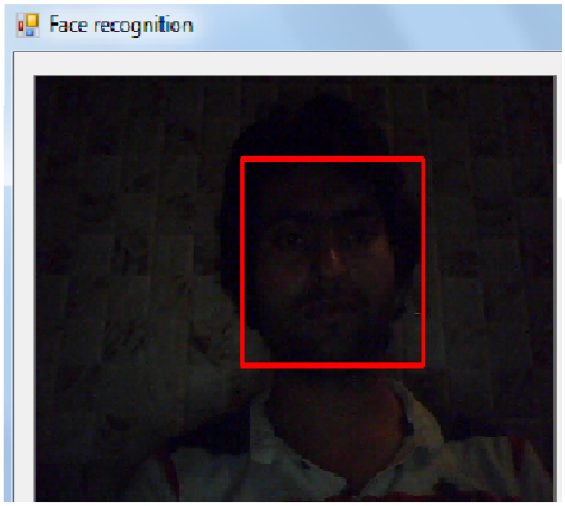
4. Experimental work

In Face Recognition , first step is camera capture. First we install emgu library and visual studio on the computer. After that we use window form application programme using emgu cv we use toolbox and make a programme using c# language. In given figure no. 5 camera capture is shown.



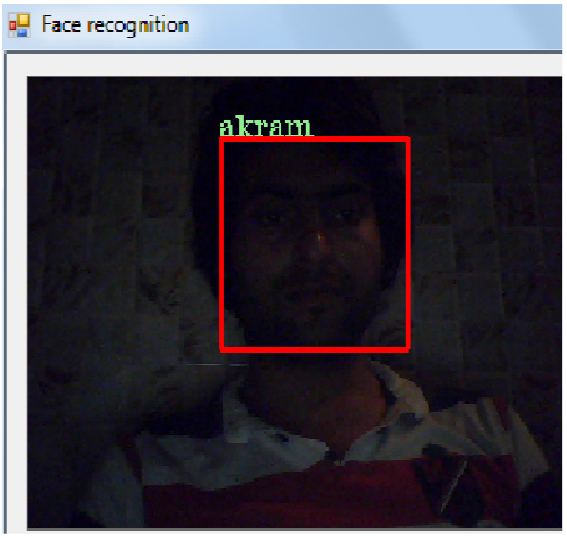
"Figure 5: Camera Capture"

In Face Recognition, second step is to detect the face. We use a rectangle which shows a face in a given picture. Here we use HAAR CASCADE algorithm to detect the face. Face detection is shown in a fifure no. 6



"Figure 6: face detection"

In Face Recognition, final stage is to recognize a face of person. After detect the face detection the system recognize the face among the persons. It is shown in figure no. 7.



"Figure 7: face recognition"

In literature, many detection algorithms based on facial features are available.

5: Face recognition algorithms

1:Eigenfaces (Eigen features)

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2: Neural networks
3: Template matching
4: Hidden markov model
5: 3D morphable model
6: Dynamic link architecture
7: Support Vector Machine (SVM)
8: Line Edge Map (LEM)

6: Applications

Face recognition is used for different types of tasks:

1. Face recognition system is used in Image database investigations (missing children, immigrants and police bookings, searching image databases of licensed drivers, benefit recipients).

2. Face recognition system is used in Criminal justice systems (booking systems, post-event analysis, forensic).

3. Face recognition system is used in .General identity verification (banking, electronic commerce, identifying newborns).

4. Face recognition system is used in Security (access control to buildings, airports/seaports, ATM machines and border
Check points, computer/ network security, email authentication on multimedia workstations).

5. Face recognition system is used in Witness face reconstruction.

6. Face recognition system is used in Multi-media environments with adaptive human-computer interfaces.

7. Face recognition system is used in video indexing like labeling faces in video.

8. Face recognition system is used in Surveillance (a large number of CCTVs can be monitored to look for known criminals, drug offenders, etc.

7: Conclusion

In this paper we have developed the face recognition system. To recognize the face, this system is divided in to some part such as perception (camera connected to the laptop), face detection, face Feature extraction, face recognition. In this system we have used Haar Cascade to detect the face and we have used eigen faces to recognize the face. In this paper, we have covered a detail discussion on the various stages of any face detection technique. Recently, face detection techniques have been employed in different applications such as face recognition, facial feature extraction, detection of facial expression, which is very important for this paper. I have shown the applications of face recognition in which area this system works. Face recognition is a challenging problem. This system solved this problem and a tremendous growth in the face recognition over the last few years. current face recognition systems have reached a certain degree of maturity when operating under constrained conditions. The ultimate goal of this paper in this area is to detect the face and recognize the face.

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