FACE RECOGNITION AND RECOGNITION IN REALTIME VIDEOS USING CNN IN MATLAB

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Abstract

The computational models, which were implemented in this paper, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable.The system with manual face detection and automatic face recognition did not have a recognition accuracy over 90%, due to the limited number of eigenfaces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate.The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area.

1. INTRODUCTION

Face recognition is the task of identifying an already detected object as a known or unknown face. Often the problem of face recognition is confused with the problem of face detection. Face Recognition on the other hand is to decide if the "face" is someone known, or unknown, using for this purpose a database of faces in order to validate this input face.

1.1 FACE DETECTION:

Face detection involves separating image windows into two classes; one containing faces (tarning the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin colour and facial expression. The problem is further complicated by differing lighting conditions, image qualities and geometries, as well as the possibility of partial occlusion and disguise. An ideal face detector would therefore be able to detect the presence of any face under any set of lighting conditions, upon any background.

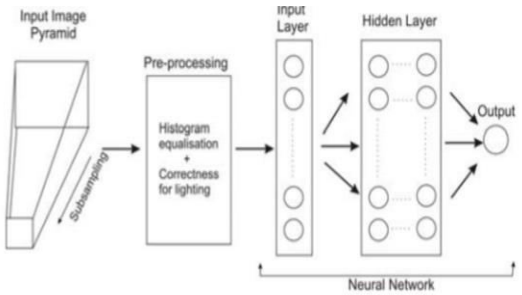


Fig1.1 : Face Detection Methodology

2 FACE RECOGNIZATION:

There are two predominant approaches to the face recognition problem: Geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many different algorithms were developed, three of which have been well studied in face recognition literature.

Figure 2 -Photometric stereo image.

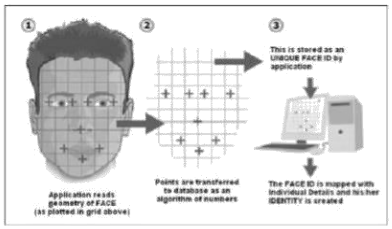


Figure 3 - Geometric facial recognition.

2. DIGITAL IMAGE PROCESSING

2.1 DIGITAL IMAGE PROCESSING

A. Improvement of pictorial information for human interpretation

B. Processing of scene data for autonomous machine perception

In this second application area, interest focuses on procedures for extracting image information in a form suitable for computer processing. Examples includes automatic character recognition, industrial machine vision for product assembly and inspection, military recognizance, automatic processing of fingerprints etc.

2.2 FUNDAMENTAL STEPS IN IMAGE PROCESSING

Image acquisition: to acquire a digital image Image pre-processing: to improve the image in ways that increases the chances for success of the other processes. Image segmentation: to partitions an input image into its constituent parts of objects. Image segmentation: to convert the input data to a from suitable for computer processing. Image description: to extract the features that result in some quantitative information of interest of features that are basic for differentiating one class of objects from another. Image recognition: to assign a label to an object based on the information provided by its description.

2.3 ELEMENTS OF DIGITAL IMAGE PROCESSING SYSTEMS

A digital image processing system contains

Two-dimensional function f(x, y).f(x, y) may be characterized by 2 components:

- The amount of source illumination i(x, y) incident on the scene
- The amount of illumination reflected r(x, y) by the objects of the scene

- f(x, y) = i(x, y)r(x, y), where 0 < i(x,y) < and 0 < r(x, y) < 1

Typical values of reflectance r(x, y):

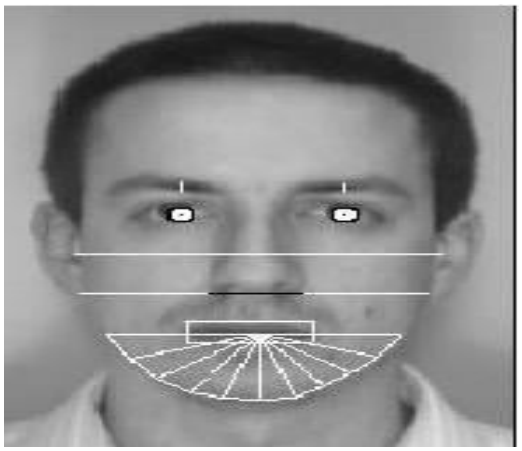
- 0.01 for black velvet
- 0.65 for stainless steel
- 0.8 for flat white wall paint
- 0.9 for silver-plated metal
- 0.93 for snow Example of typical ranges of illumination i(x, y) for visible light (average values)
- Sun on a clear day: ~90,000 lm/m^2,down to 10,000lm/m^2 on a cloudy day
- Full moon on a clear evening :-0.1 lm/m^2

2.4 FACE DETECTION

The problem of face recognition is all about face detection. This is a fact that seems quite bizarre to new researchers in this area. However, before face recognition is possible, one must be able to reliably find a face and its landmarks. This is essentially a segmentation problem and in practical systems, most of the effort goes into solving this task. In fact the actual recognition based on features extracted from these facial landmarks is only a minor last step.

There are two types of face detection problems:

1) Face detection in images and



2) Real-time face detection

2.5 FACE DETECTION IN IMAGES

Figure 2.2 A successful face detection in an image with a frontal view of a human face.

Most face detection systems attempt to extract a fraction of the whole face, thereby eliminating most of the background and other areas of an individual's head such as hair that are not necessary for the face recognition task. With static images, this is often done by running a across the image. The face detection system then judges if a face is present inside the window (Brunelli and Poggio, 1993). Unfortunately, with static images there is a very large search space of possible locations of a face in an image Most face detection systems use an example based learning approach to decide whether or not a face is present in the *window* at that given instant (Sung and Poggio,1994 and Sung,1995). A neural network or some other classifier is trained

3. FACE RECOGNITION

Over the last few decades many techniques have been proposed for face recognition. Many of the techniques proposed during the early stages of computer vision cannot be considered successful, but almost all of the recent approaches to the face recognition problem have been creditable. According to the research by Brunelli and Poggio (1993) all approaches to human face recognition can be divided into two strategies:

(1) Geometrical features and

(2) Template matching.

3.1 FACE RECOGNITION USING GEOMETRICAL FEATURES

This technique involves computation of a set of geometrical features such as nose width and length, mouth position and chin shape, etc. from the picture of the face we want to recognize. This set of features is then matched with the features of known individuals. A suitable metric such as Euclidean distance (finding the closest vector) can be used to find the closest match. Most pioneering work in face recognition was done using geometric features (Kanade, 1973), although Craw et al. (1987) did relatively recent work in this area.

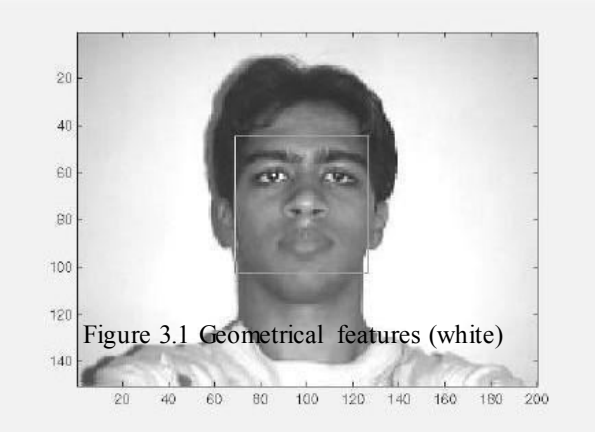


Figure 3.1 Geometrical features (white)

which could be used for face recognition

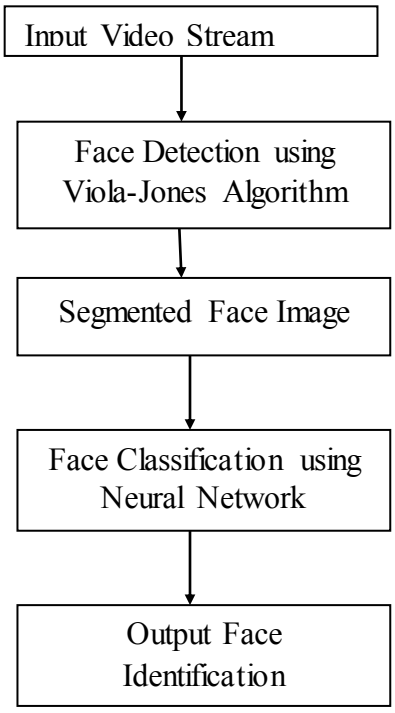
The advantage of using geometrical features as a basis for face recognition is that recognition is possible even at very low resolutions and with noisy images (images with many disorderly pixel intensities). Although the face cannot be viewed in detail its overall geometrical configuration can be extracted for face recognition. The technique's main disadvantage is that automated extraction of the facial geometrical features is very hard. Automated geometrical feature extraction based recognition is also very sensitive to the scaling and rotation of a face in the image plane (Brunelli and Poggio, 1993). This is apparent when we examine Kanade's(1973) results where he reported a recognition rate of between 45-75 % with a database of only 20 people. However if these features are extracted manually as in Goldstein et al. (1971), and Kaya and Kobayashi (1972) satisfactory results may be obtained.

4.PROPOSED METHOD

Our paper of real time face identification through camera video analysis involves two major operations namely,

- Face Detection
- Face Identification

Face Detection is achieved by Viola-Jones Algorithm which is considered as one of the best feature based algorithm with highest accuracy taking less time. For that the input video is segregated into individual image frames then applied with the algorithm.



Face Identification is achieved by neural network. For that the network should be trained initially before the testing process with valid input datas (Face Images) that can be created by ourselves initially by sample videos and separate the the face images as datasets.

4.1 Viola Jones Method for Face Detection:

Paul Viola and Michael Jones presented an approach for object detection which minimizes computation time while achieving high detection accuracy. Paul Viola and Michael Jones proposed a fast and robust method for face detection which is 15 times quicker than any technique at the time of release with 95% accuracy at around 17 fps.The technique relies on the use of simple Haar-like features that are evaluated quickly through the use of a new image representation. Based on the concept of an ―Integral Image‖ it generates a large set of features and uses the boosting algorithm AdaBoost to reduce the overcomplete set and the introduction of a degenerative tree of the boosted classifiers provides for robust and fast interferences. The detector is applied in a scanning fashion and used on gray-scale images, the scanned window that is applied can also be scaled, as well as the features evaluated.

5.CONCLUSION

The fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale, rotation or shift errors of the segmented face image. This was one of the system requirements identified in section 2.3. However, if some sort of further processing, such as an eye detection technique, was implemented to further normalise the segmented face image, performance will increase to levels comparable to the manual face detection and recognition system. Implementing an eye detection technique would be a minor extension to the implemented system and would not require a great deal of additional research.All other implemented systems displayed commendable results and reflect well on the deformable template and Principal Component Analysis strategies.The most suitable real-world applications for face detection and recognition systems are for mugshot matching and surveillance. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since these need a very high degree of accuracy.The real-time automated pose invariant face detection and recognition system proposed in chapter seven would be ideal for crowd surveillance applications. If such a system were widely implemented its potential for locating and tracking suspects for law enforcement agencies is immense.

The implemented fully automated face detection and recognition system (with an eye detection system) could be used for simple surveillance applications such as ATM user security, while the implemented manual face detection and automated recognition system is ideal of mugshot matching. Since controlled conditions are present when mugshots are gathered, the frontal view face recognition scheme should display a recognition accuracy far better than the results, which were obtained in this study, which was conducted under adverse conditions.

Furthermore, many of the test subjects did not present an expressionless, frontal view to the system. They would probably be more compliant when a 6'5" policeman is taking their mugshot! In mugshot matching applications, perfect recognition accuracy or an exact match is not a requirement. If a face recognition system can reduce the number of images that a human operator has to search through for a match from 10000 to even a 100, it would be of incredible practical use in law enforcement.

The automated vision systems implemented in this thesis did not even approach the performance, nor were they as robust as a human's innate face recognition system. However, they give an insight into what the future may hold in computer vision.

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