FACE RECOGNITION AND GENDER CLASSIFICATION

A Report for the of Project 2

Submitted by

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in partial fulfillment For the award of the degree of

Bachelor of Technology

IN

Computer Science and Engineering

SCHOOL OF COMPUTING SCIENCE AND ENGINEERING

Under the Supervision of

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APRIL / MAY- 2020

SCHOOL OF COMPUTING AND SCIENCE AND ENGINEERING

BOAFIDE CERTIFICATE

Certified that this project report **"Face Recognition and Gender Classification "** is the bonafide work of "**AMAN VERMA(1613101109)**" who carried out the project work under my supervision.

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ACKNOWLEDGEMENT

I thanks my advisor, Pratyush kumar Deka, whose guidance , support,and dedication is priceless. Dr.D. maria manuel vianny is an educator in the truest sense of the word.
I especially thanks to IEEE (Institute of Electrical and Electronics Engineers, Inc.) for providing recent information about my topic.

It has been a challenging,yet rewarding journey which I could not have completed alone and I am grateful for your support.
Thank you.

Abstract

Perceiving human faces and modelling the distinctive features of human faces that contribute most towards

face recognition are some of the challenges faced by computer vision and psychophysics researchers. There are many methods have been proposed in the literature for the facial features and gender classification. However, all of them have still disadvantage such as not complete reflection about face structure, face texture. The features set is applied to three different applications: face recognition, facial expressions recognition and gender classification, which produced the reasonable results in all database. This project describes two phases such as feature extraction phase and classification phase. The proposed system produced very promising recognition rates for our applications with same set of features and classifiers. The system is also real-time capable and automatic.In this thesis, a photometric (view based) approach is used for face recognition and gender classification. There exist several algorithms to extract features such as Principal Component Analysis (PCA), Fisher Linear Discriminate Analysis (FLDA), Image principal component analysis (IPCA), and various others. Principal component analysis is used for the dimensional reduction and for the feature extraction. Two face databases are taken in which one database contains the face images of male and one contains face images of females. On the basis of Euclidean Distance classification of the gender is done.

INDEX

CONTENTS **page**

INTRODUCTION

A face recognition system is one of the popular Computer Application for automatic verification or identification of any person either from a given image or from any video source. Face recognition is mainly used for the security purpose and one can compare this with the other biometrics like fingerprint, iris recognition system. The main advantages of a face recognition system over the other biometrics application is that it not necessary need to ask the person to come in front of camera or in any sensor like in other it required the person should take his body in front of the sensor and stay there for few second. For the face recognition if a person is simply walking from any surveillance camera it can capture information of the person without his/her knowing about that and can identify or verify the person. In a face recognition problem we are simply giving an input image and the facial database of the person known individuals and it identify or verify the given image. There are basically two approaches for the face recognition: geometrics (feature based) and photometric (view based). In the geometrics we need to select only some distinctive features like nose, eyes, mouth and measure the geometric relationship among these facial points. The mostly used algorithm for face recognition is Principal Component Analysis (PCA) is example of photometric based approach. Face recognition steps: The face recognition is mainly done by performing the following process:

1. **Image acquisition:** This is the very first step for the face recognition in this required to acquisition of any image either by camera or by any other source.

Image Preprocessing: Some preprocessing is required to perform before using the acquired image

2. Face detection: After doing the preprocessing now it required to detect the face from the given image. Since for performing the face recognition we basically need a face of any person. So the face detection is done before performing the face recognition.

3. Feature extraction: The next step after face detection is extracting the important features of the face which can be used for comparing with the image database of individuals.

4. Declaring a match: After performing the above steps it required to identify or verify the given image from the database. In this we can classify any given image in face or non-face or in any other groups according to the requirement. The face recognition is mainly used for the verification and identification.

FACE RECOGNIZATION:

DIFFERENT APPROACHES OF FACE RECOGNITION:

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.

Recognition algorithms can be divided into two main approaches:

1. **Geometric:** Is based on geometrical relationship between facial landmarks, or in other words the spatial configuration of facial features. That means that the main geometrical features of the face such as the eyes, nose and mouth are first located and then faces are classified on the basis of various geometrical distances and angles between features. (Figure 3)
2. **Photometric stereo:** Used to recover the shape of an object from a number of images taken under different lighting conditions. The shape of the recovered object is defined by a gradient map, which is made up of an array of surface normal (Zhao and Chalupa, 2006) (Figure 2)

Popular recognition algorithms include:

1. Principal Component Analysis using Eigenfaces, (PCA)
2. Linear Discriminate Analysis,
3. Elastic Bunch Graph Matching using the Fisher face algorithm,

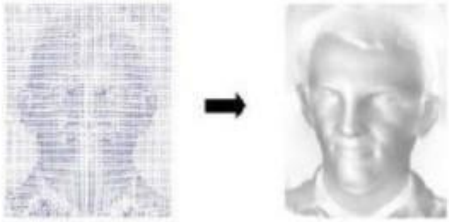

Figure 2 -Photometric stereo image.

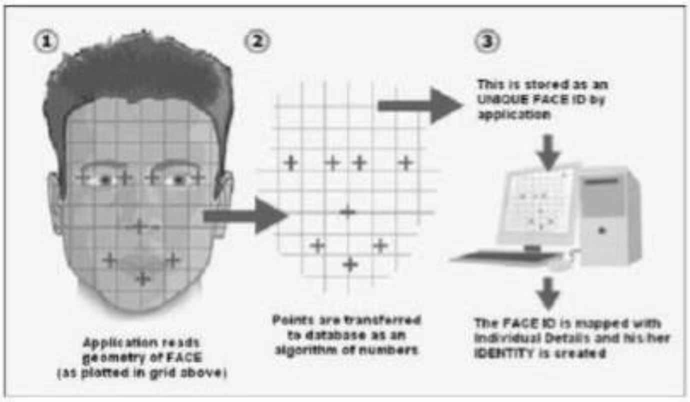

Figure 3 - Geometric facial recognition.

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1.2 FACE DETECTION:

Face detection involves separating image windows into two classes; one containing face's training the background (clutter). It is difficult because although commonalities exist between faces, they can vary considerably in terms of age, skin color 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. The face detection task can be broken down into two steps. The first step is a classification task that takes some arbitrary image as input and outputs a binary value of yes or no, indicating whether there are any faces present in the image. The second step is the face localization task that aims to take an image as input and output the location of any face or faces within that image as some bounding box with (x, y, width, height).

The face detection system can be divided into the following steps: -

1.Pre-Processing: To reduce the variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping

images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.

1. Classification: Neural networks are implemented to classify the images as faces or nonfaces by training on these examples. We use both our implementation of the neural network and the MATLAB neural network toolbox for this task. Different network configurations are experimented with to optimize the results.

2. Localization: The trained neural network is then used to search for faces in an image and if present localize them in a bounding box. Various Feature of Face on which the work has done on:- Position Scale Orientation Illumination

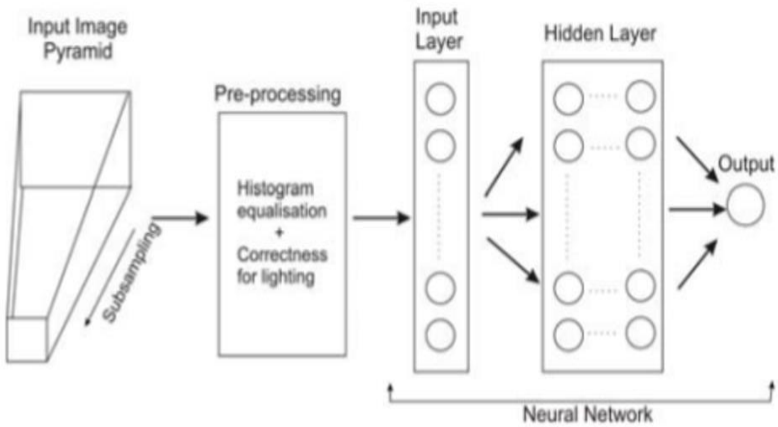

Fig: Face detection algorithm

LITERATURE SURVEY

Face detection is a computer technology that determines the location and size of human face in arbitrary (digital) image. The facial features are detected and any other objects like trees, buildings and bodies etc are ignored from the digital image. It can be regarded as a _specific 'case of object-class detection, where the task is finding the location and sizes of all objects in an image that belong to a given class. Face detection, can be regarded as a more _general 'case of face localization. In face localization, the task is to find the locations and sizes of a known number of faces (usually one). Basically, there are two types of approaches to detect facial part in the given image i.e. feature base and image base approach. Feature base approach tries to extract features of the image and match it against the knowledge of the face features. While image base approach tries to get best match between training and testing images.

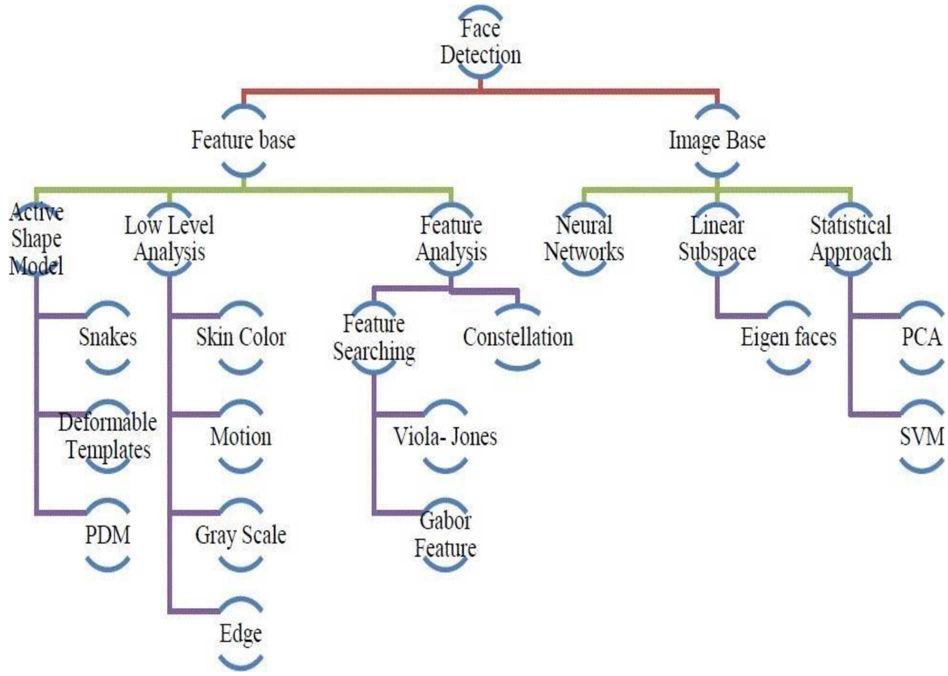

Fig 2.1 detection methods

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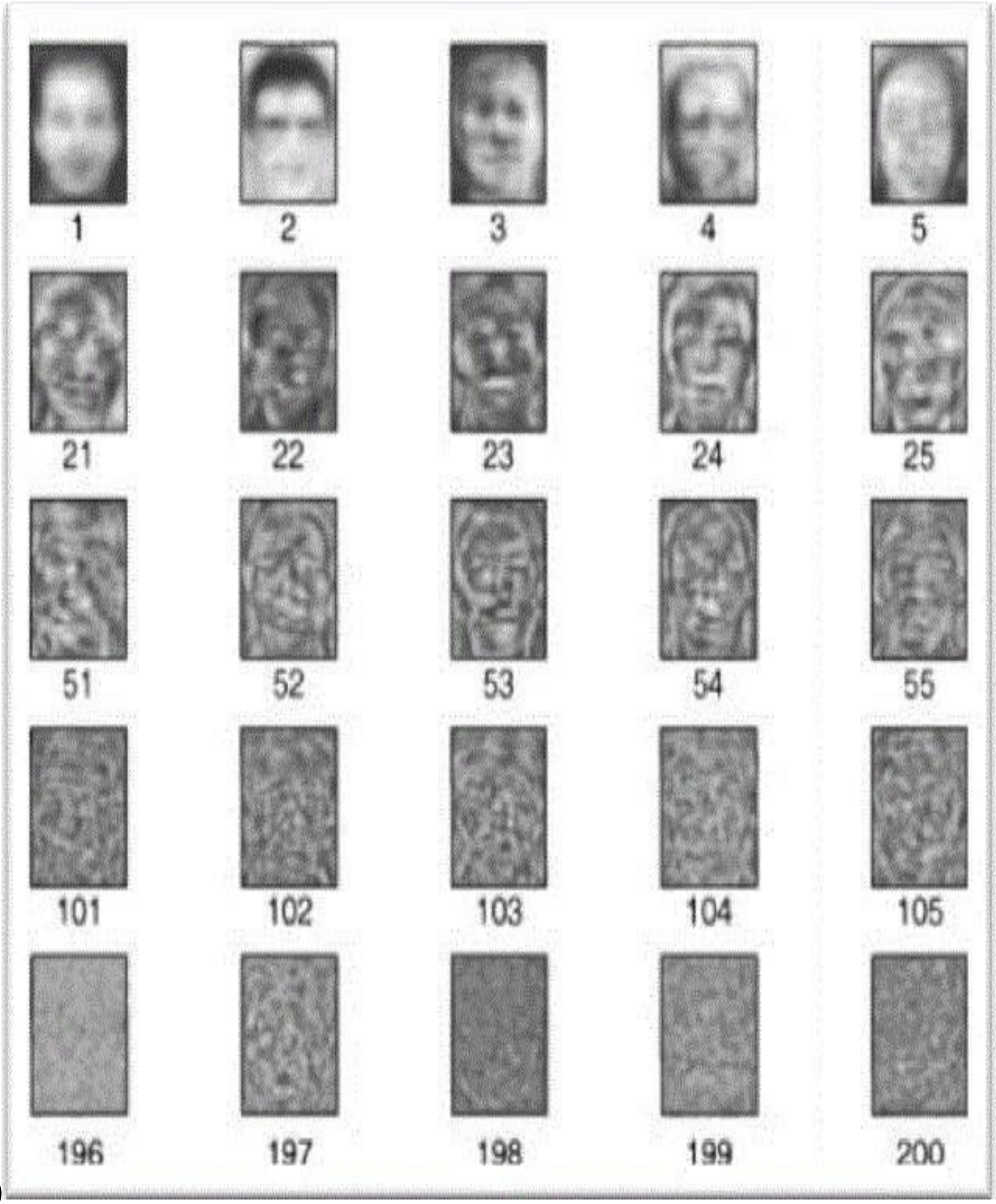


Fig 2.2. face detection

Majorly three different face detection algorithms are available based on RGB, YCbCr, and HIS color space models. In the implementation of the algorithms there are three main steps viz.

(1) Classify the skin region in the color space,

(2) Apply threshold to mask the skin region and

(3) Draw bounding box to extract the face image.

Crowley and Coutaz suggested simplest skin color algorithms for detecting skin pixels. The perceived human color varies as a function of the relative direction to the illumination.

The pixels for skin region can be detected using a normalized color histogram, and can be normalized for changes in intensity on dividing by luminance. Converted an [R, G, B] vector is converted into an [r, g] vector of normalized color which provides a fast means of skin detection. This algorithm fails when there is some more skin region like legs, arms, etc. Chai and Ngan [27] suggested skin color classification algorithm with YCbCr color space. Research found that pixels belonging to skin region having similar Cb and Cr values. So that the thresholds be chosen as [Cr1, Cr2] and [Cb1, Cb2], a pixel is classified to have skin tone if the values [Cr, Cb] fall within the thresholds. The skin color distribution gives the face portion in the color image. This algorithm is also having the constraint that the image should be having only face as the skin region. Kjeldsen and Kinder defined a color predicate in HSV color space to separate skin regions from background. Skin color classification in HSI color space is the same as YCbCr color space but here the responsible values are hue (H) and saturation (S). Similar to above the threshold be chosen as [H1, S1] and [H2, S2], and a pixel is classified to have skin tone if the values [H,S] fall within the threshold and this distribution gives the localized face image. Similar to above two algorithm this algorithm is also having the same constraint.

2.2) MOTION BASE:

When use of video sequence is available, motion information can be used to locate moving objects. Moving silhouettes like face and body parts can be extracted by simply thresholding accumulated frame differences. Besides face regions, facial features can be located by frame differences.

2.2.1 Gray Scale Base:

Gray information within a face can also be treat as important features. Facial features such as eyebrows, pupils, and lips appear generally darker than their surrounding facial regions. Various recent feature extraction algorithms search for local gray minima within segmented facial regions. In these algorithms, the input images are first enhanced by contrast-stretching and gray-scale morphological routines to improve the quality of local dark patches and thereby make detection easier. The extraction of dark patches is achieved by low-level gray-scale thresholding. Based method and consist three levels. Yang and hang presented new approach i.e. faces gray scale behavior in pyramid (mosaic) images. This system utilizes hierarchical Face location consist three levels. Higher two level based on mosaic images at different resolution. In the lower level, edge detection method is proposed. Moreover, this algorithm gives fine response in complex background where size of the face is unknown

2.2.2 Edge Base:

Face detection based on edges was introduced by Sakai et al. This work was based on analyzing line drawings of the faces from photographs, aiming to locate facial features. Than later Craw et al. proposed a hierarchical framework based on Sakai et al. ‘work to trace a human head outline. Then after remarkable works were carried out by many researchers in this specific area. Method suggested by Anile and Devarajan was very simple and fast. They proposed frame work which consist three stepwise. initially the images are enhanced by applying median filter for noise removal and histogram equalization for contrast adjustment. In the second step the edge images constructed from the enhanced image by applying sober operator. Then a novel edge tracking algorithm is applied to extract the sub windows from the enhanced image based on edges. Further they used Back propagation Neural Network (BPN) algorithm to classify the sub-window as either face or non-face.

DIGITAL IMAGE PROCESSING

3.1 DIGITAL IMAGE PROCESSING

Interest in digital image processing methods stems from two principal application areas:

1. Improvement of pictorial information for human interpretation
2. 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.

Image:

Am image refers a 2D light intensity function f(x, y), where(x, y) denotes spatial coordinates and the value of f at any point (x, y) is proportional to the brightness or gray levels of the image at that point. A digital image is an image f(x, y) that has been discretized both in spatial coordinates and brightness. The elements of such a digital array are called image elements or pixels.

A simple image model:

To be suitable for computer processing, an image f(x, y) must be digitalized both spatially and in amplitude. Digitization of the spatial coordinates (x, y) is called image sampling. Amplitude digitization is called gray-level quantization.

The storage and processing requirements increase rapidly with the spatial resolution and the number of gray levels.

Example: A 256 gray-level image of size 256x256 occupies 64k bytes of memory.

Types of image processing

- Low level processing
- Medium level processing
- High level processing

Low level processing means performing basic operations on images such as reading an image resize, resize, image rotate, RGB to gray level conversion, histogram equalization etc…, The output image obtained after low level processing is raw image. Medium level processing means extracting regions of interest from output of low level processed image. Medium level processing deals with identification of boundaries i.e, edges .This process is called segmentation. High level processing deals with adding of artificial intelligence to medium level processed signal.

3.2 FUNDAMENTAL STEPS IN IMAGE PROCESSING

Fundamental steps in image processing are

1. Image acquisition: to acquire a digital image

2. Image pre-processing: to improve the image in ways that increases the chances for success of the other processes.

3. Image segmentation: to partitions an input image into its constituent parts of objects.

4. Image segmentation: to convert the input data to a from suitable for computer processing.

5. 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.

6. Image recognition: to assign a label to an object based on the information provided by its description.

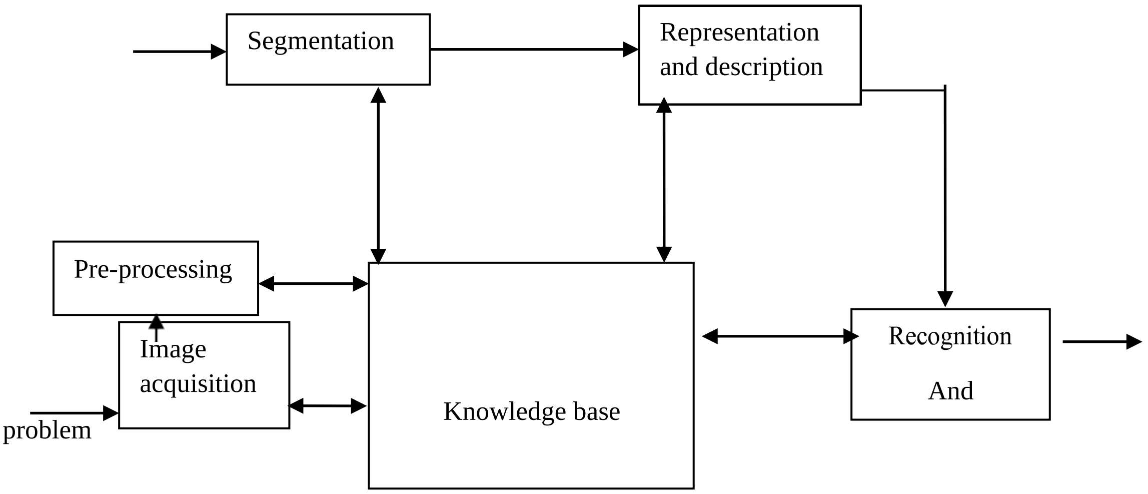


fig.3.1. Fundamental steps in digital image processing

3.3 ELEMENTS OF DIGITAL IMAGE PROCESSING SYSTEMS

A digital image processing system contains the following blocks as shown in the figure

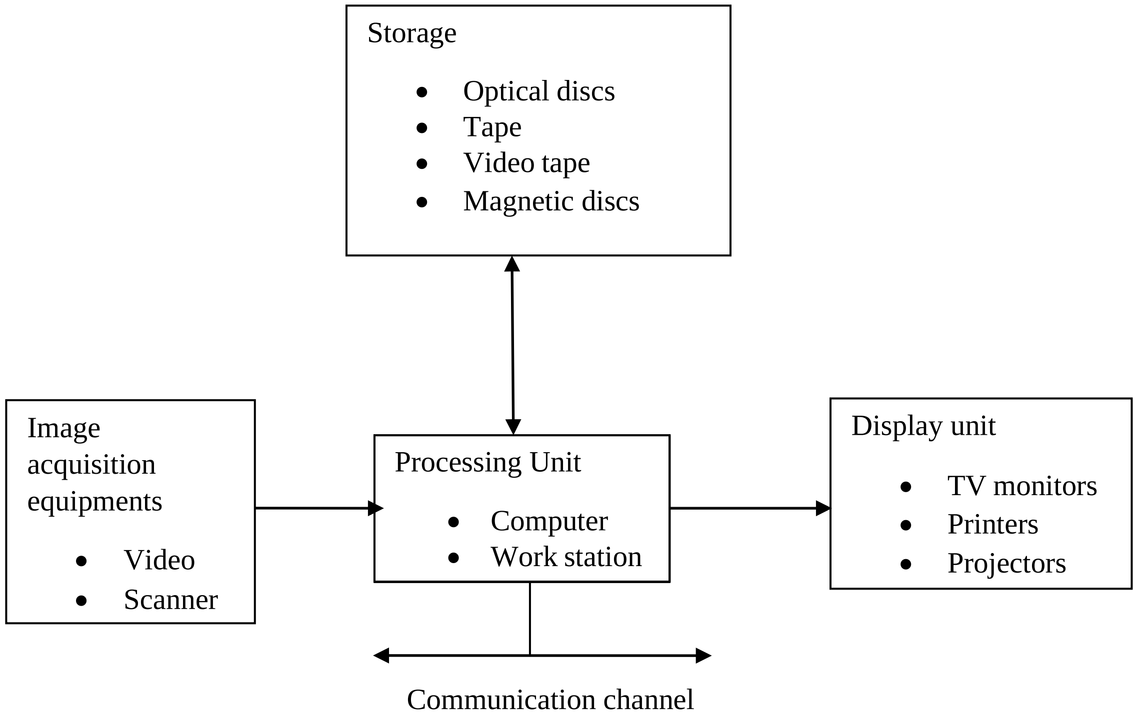


Fig.3.3. Elements of digital image processing systems

The basic operations performed in a digital image processing system include

1. Acquisition
2. Storage
3. Processing
4. Communication
5. Display

3.3.1 A simple image formation model

Image are denoted by two-dimensional function f(x, y).f(x, y) may be characterized by 2 components:

1. The amount of source illumination i(x, y) incident on the scene
2. The amount of illumination reflected r(x, y) by the objects of the scene
3. $f(x, y) = i(x, y)r(x, y)$, where $0 < i(x,y) <$ and $0 < r(x, y) < 1$

PROBLEMS OF FACE RECOGNITION

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

5.1 FACE DETECTION IN IMAGES

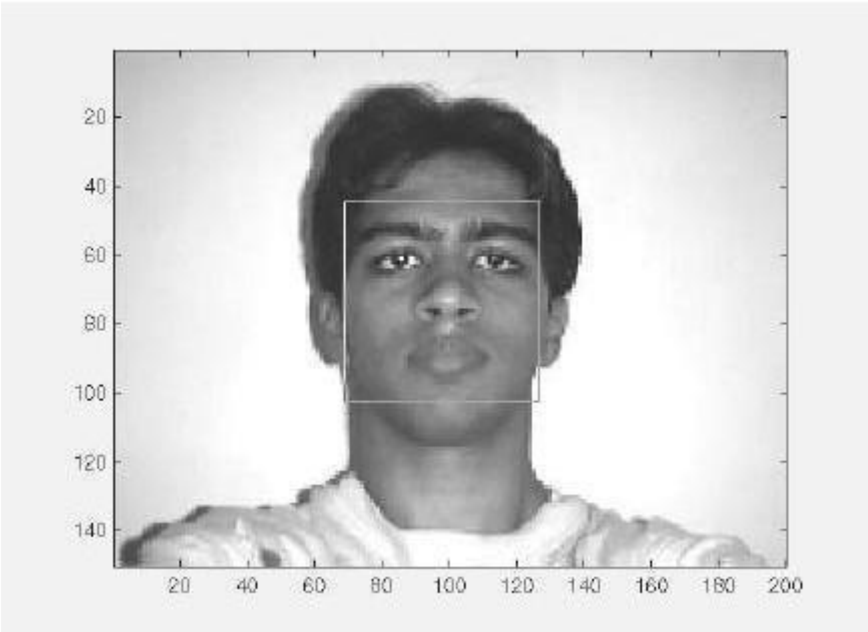


Figure 5.1 A successful face detection in an image with a frontal view of a human face.

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 using supervised learning with 'face' and 'non-face' examples, thereby enabling it to classify an image (*window* in face detection system) as a 'face' or 'non-face'.. Unfortunately, while it is relatively easy to find face examples, how would one find a representative sample of images which represent non-faces (Rowley et al., 1996)? Therefore, face detection systems using example based learning need thousands of 'face' and 'non- face' images for effective training. Rowley, Baluja, and Kanade (Rowley et al.,1996) used 1025 face images and 8000 non-face images (generated from 146,212,178 sub-images) for their training set!

A face detection scheme that is related to template matching is image invariants. Here the fact that the local ordinal structure of brightness distribution of a face remains largely unchanged under different illumination conditions (Sinha, 1994) is used to construct a spatial template of the face which closely corresponds to facial features. In other words, the average grey-scale intensities in human faces are used as a basis for face detection. For example, almost always an individuals eye region is darker than his forehead or nose. Therefore an image will match the template if it satisfies the 'darker than' and 'brighter than' relationships (Sung and Poggio, 1994).

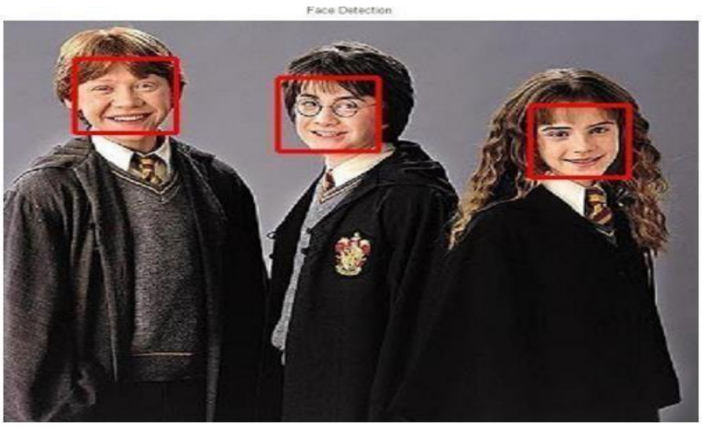
5.2 REAL-TIME FACE DETECTION

Real-time face detection involves detection of a face from a series of frames from a video-capturing device. While the hardware requirements for such a system are far more stringent, from a computer vision stand point, real-time face detection is actually a far simpler process than detecting a face in a static image. This is because unlike most of our surrounding environment, people are continually moving. We walk around, blink, fidget, wave our hands about, etc.

Figure 5.2.1: Frame 1 from camera

Figure 5.2.2: Frame 2 from camera

FACE DETECTION PROCESS



Face detection

It is process of identifying different parts of human faces like eyes, nose, mouth, etc. To do this it would be useful to study the grey- scale intensity distribution of an average human face. The following 'average human face' was constructed from a sample of 30 frontal view human faces, of which 12 were from females and 18 from males. A suitably scaled colormap has been used to highlight grey-scale intensity differences.

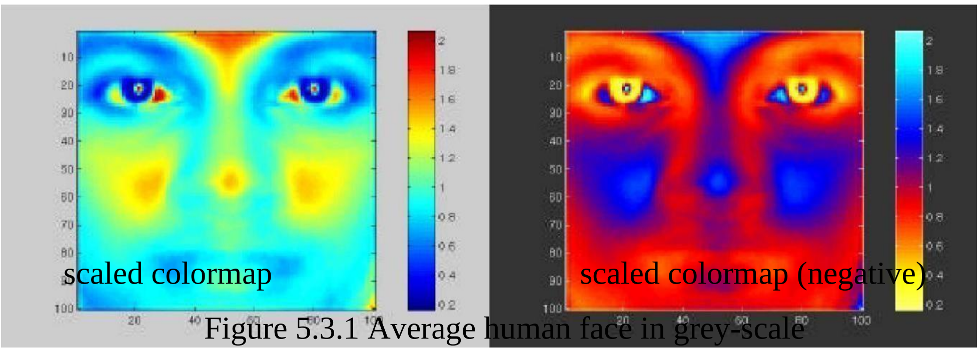
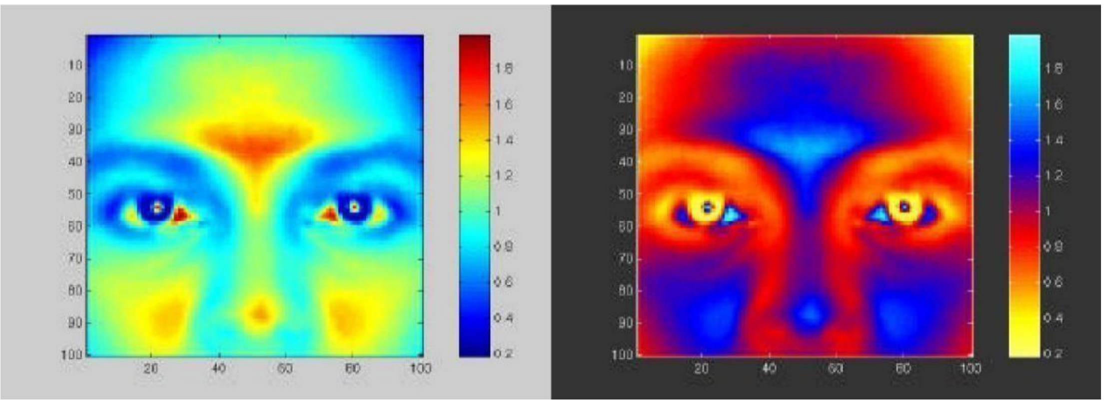


Figure 5.3.1 Average human face in grey-scale

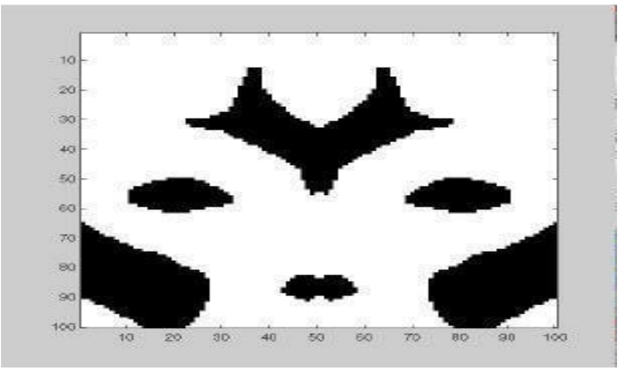
The grey-scale differences, which are invariant across all the sample faces are strikingly apparent. The eye-eyebrow area seem to always contain dark intensity (low) gray-levels while nose forehead and cheeks contain bright intensity (high) grey-levels. After a great deal of experimentation, the researcher found that the following areas of the human face were suitable for a face detection system based on image invariants and a deformable template.



scaled colormap   scaled colormap (negative)

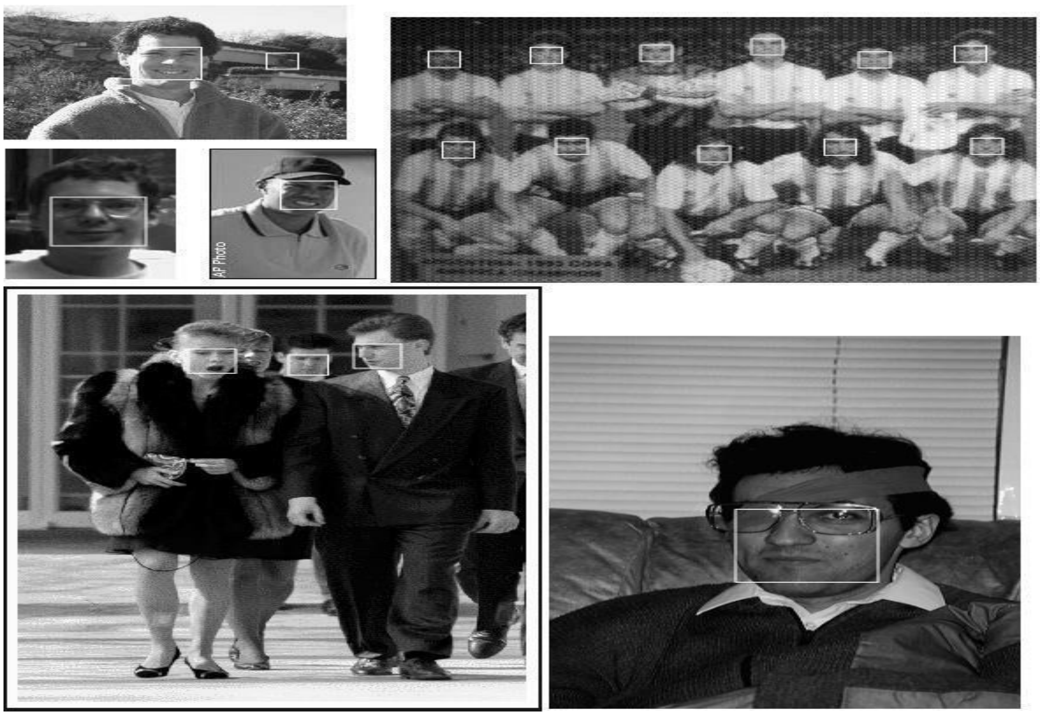
Area chosen for face detection (indicated on average human face in gray scale)

The above facial area performs well as a basis for a face template, probably because of the clear divisions of the bright intensity invariant area by the dark intensity invariant regions. Once this pixel area is located by the face detection system, any particular area required can be segmented based on the proportions of the average human face After studying the above images it was subjectively decided by the author to use the following as a basis for dark intensity sensitive and bright intensity sensitive templates. Once these are located in a subject's face, a pixel area 33.3% (of the width of the square window) below this.



Basis for a bright intensity invariant sensitive template

Note the slight differences which were made to the bright intensity invariant sensitive template which were needed because of the pre-processing done by the system to overcome irregular lighting (chapter six). Now that a suitable dark and bright intensity invariant templates have been decided on, it is necessary to find a way of using these to make 2 A-units for a perceptron, i.e. a computational model is needed to assign neurons to the distributions displayed .



Scaned image detection

FACE DETECTION ALGORITHM

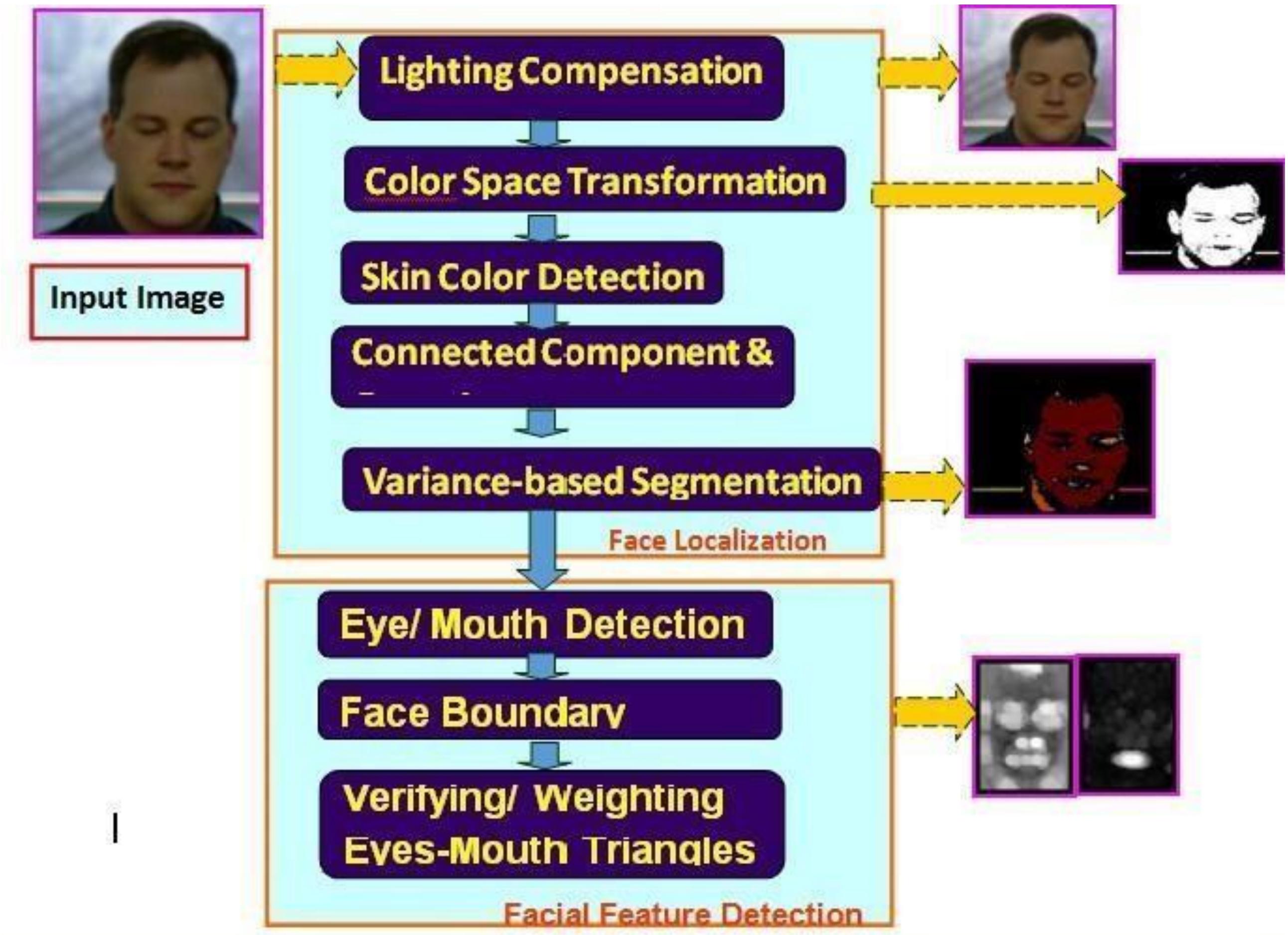


Fig 5.4.1 mouth detection

Fig 5.4.2 Noise detection

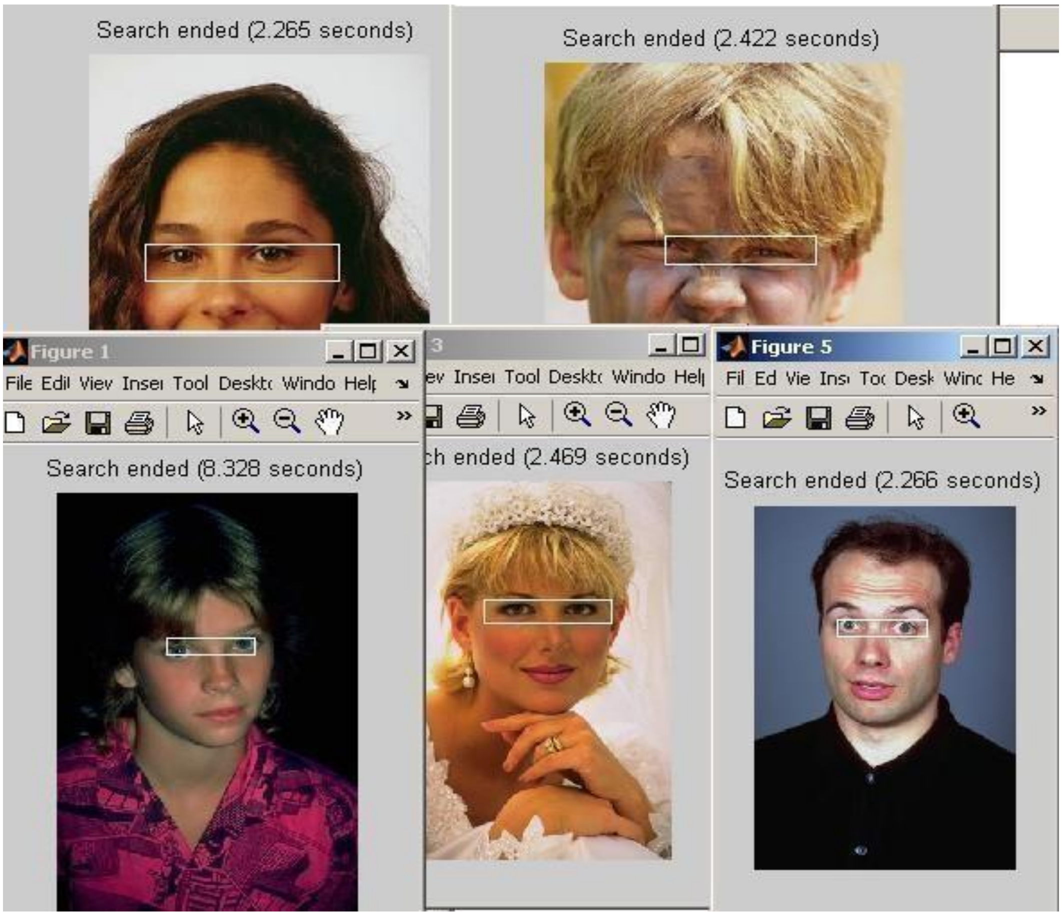


Fig 5.4.3 Eye detection

CHAPTER-6

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.

6.1 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.

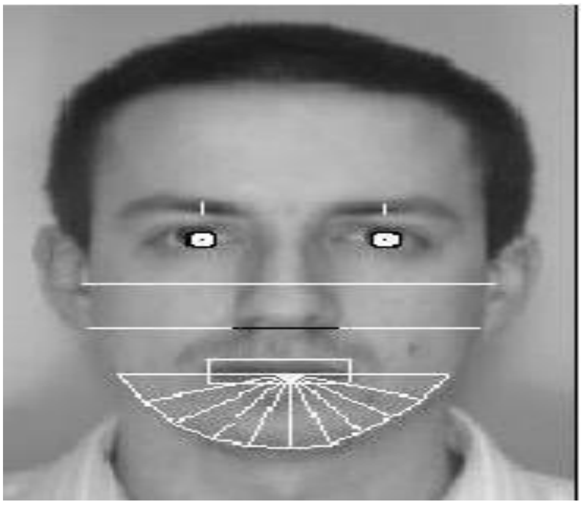
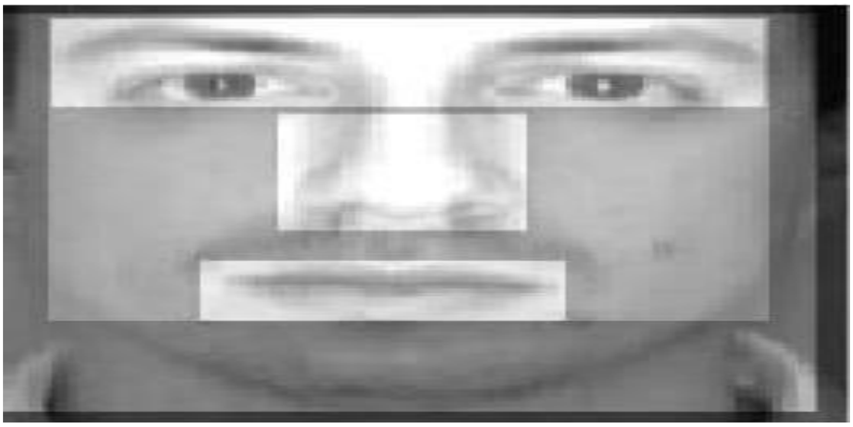


Figure 6.1 Geometrical features (white) which could be used for face recognition

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.

6.1.1 Face recognition using template matching

This is similar the template matching technique used in face detection, except here we are not trying to classify an image as a 'face' or 'non-face' but are trying to recognize a face.



Face recognition using template matching

Whole face, eyes, nose and mouth regions which could be used in a template matching strategy. The basis of the template matching strategy is to extract whole facial regions (matrix of pixels) and compare these with the stored images of known individuals. Once again Euclidean distance can be used to find the closest match. The simple technique of comparing grey-scale intensity values for face recognition was used by Baron (1981). However there are far more sophisticated methods of template matching for face recognition. These involve extensive pre-processing and transformation of the extracted grey-level intensity values. For example, Turk and Pentland (1991a) used Principal Component Analysis, sometimes known as the eigenfaces approach, to pre-process the gray-levels and Wiskott et al. (1997) used Elastic Graphs encoded using Gabor filters to pre-process the extracted regions. An investigation of geometrical features versus template matching for face recognition by Brunelli and Poggio (1993) came to the conclusion that although a feature based strategy may offer higher recognition speed and smaller memory requirements, template based techniques offer superior recognition accuracy.

PROBLEM SCOPE AND SYSTEM SPECIFICATION

The following problem scope for this project was arrived at after reviewing the literature on face detection and face recognition, and determining possible real-world situations where such systems would be of use. The following system(s) requirements were identified

1 A system to detect frontal view faces in static images

2 A system to recognize a given frontal view face

3 Only expressionless, frontal view faces will be presented to the face detection&recognition

4 All implemented systems must display a high degree of lighting invariency.

5 All systems must posses near real-time performance.

6 Both fully automated and manual face detection must be supported

7 Frontal view face recognition will be realised using only a single known image

8 Automated face detection and recognition systems should be combined into a fully automated face detection and recognition system. The face recognition sub-system must display a slight degree of invariency to scaling and rotation errors in the segmented image extracted by the face detection sub-system.

9 The frontal view face recognition system should be extended to a pose invariant face recognition system.

Unfortunately although we may specify constricting conditions to our problem domain, it may not be possible to strictly adhere to these conditions when implementing a system in the real-world.

6.2 BRIEF OUT LINE OF THE IMPLEMENTED SYSTEM

Fully automated face detection of frontal view faces is implemented using a deformable template algorithm relying on the image invariants of human faces. This was chosen because a similar neural-network based face detection model would have needed far too much training data to be implemented and would have used a great deal of computing time. The main difficulties in implementing a deformable template based technique were the creation of the bright and dark intensity sensitive templates and designing an efficient implementation of the detection algorithm.

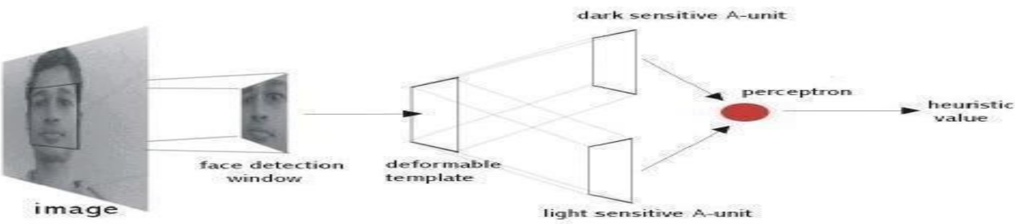


Figure 6.3 Implemented fully automated frontal view face detection model

A manual face detection system was realised by measuring the facial proportions of the average face, calculated from 30 test subjects. To detect a face, a human operator would identify the locations of the subject's eyes in an image and using the proportions of the average face, the system would segment an area from the image

A template matching based technique was implemented for face recognition. This was because of its increased recognition accuracy when compared to geometrical features based techniques and the fact that an automated geometrical features based technique would have required complex feature detection pre-processing.

Of the many possible template matching techniques, Principal Component Analysis was chosen because it has proved to be a highly robust in pattern recognition tasks and because it is relatively simple to implement. The author would also liked to have implemented a technique based on Elastic Graphs but could not find sufficient literature about the model to implement such a system during the limited time available for this project.

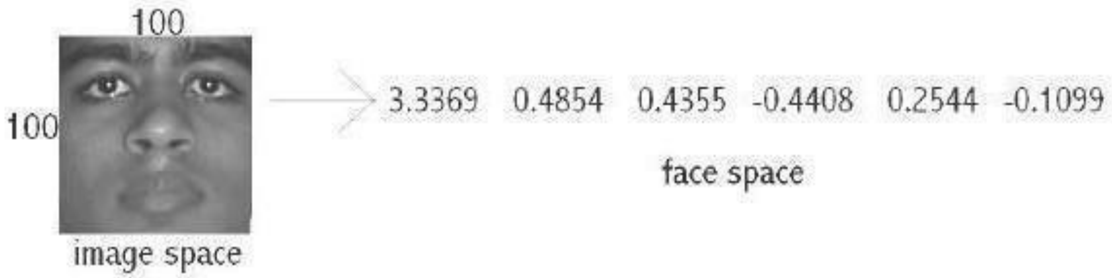


Figure 6.3.1: Principal Component Analysis transform from 'image space' to 'face space'.

Using Principal Component Analysis, the segmented frontal view face image is transformed from what is sometimes called 'image space' to 'face space'. All faces in the face database are transformed into face space. Then face recognition is achieved by transforming any given test image into face space and comparing it with the training set vectors. The closest matching training set vector should belong to the same individual as the test image.Principal Component Analysis is of special interest because the transformation to face space is based on the variation of human faces (in the training set). The values of the 'face space' vector correspond to the amount certain 'variations' are present in the test image

Face recognition and detection system is a pattern recognition approach for personal identification purposes in addition to other biometric approaches such as fingerprint recognition, signature, retina and so forth. Face is the most common biometric used by humans applications ranges from static, mug-shot verification in a cluttered background.

Face Recognition

FACE RECOGNITION DIFFICULTIES

1. Identify similar faces (inter-class similarity)
2. Accommodate intra-class variability due to
   - 2.1 head pose
   - 2.2 illumination conditions
   - 2.3 expressions
   - 2.4 facial accessories
   - 2.5 aging effects
3. Cartoon faces

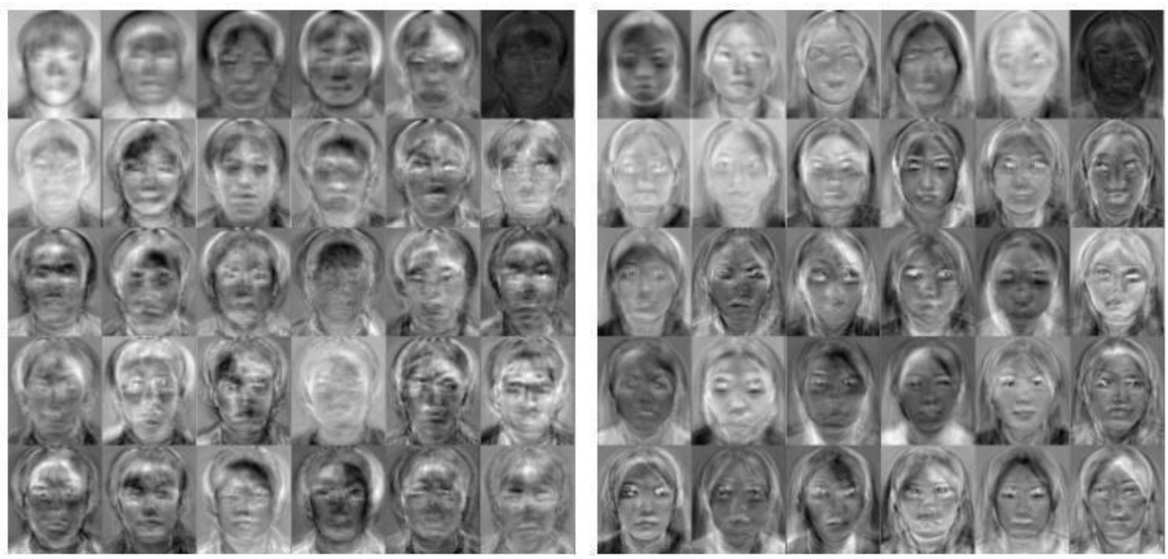
6.2.1 Inter - class similarity:

- Different persons may have very similar appearance

Face recognition twins

Face recognition and detection system is a pattern recognition approach for personal identification purposes in addition to other biometric approaches such as fingerprint recognition, signature, retina and so forth. The variability in the faces, the images are processed before they are fed into the network. All positive examples that is the face images are obtained by cropping images with frontal faces to include only the front view. All the cropped images are then corrected for lighting through standard algorithms.

space. Face recognition using these images is doomed to failure because all human face images are quite similar to one another so all associated vectors are very close to each other in the 10000-dimension space.



Eigenfaces

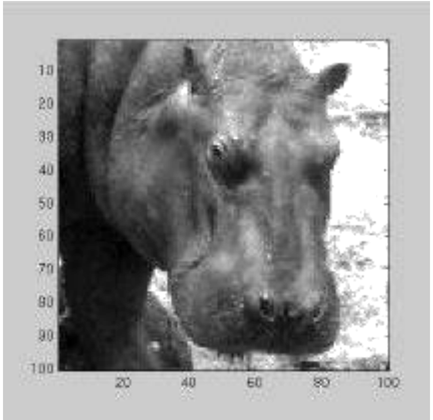
There are four possibilities:

1. Projected image is a face and is transformed near a face in the face database
2. Projected image is a face and is not transformed near a face in the face database
3. Projected image is not a face and is transformed near a face in the face database
4. Projected image is not a face and is not transformed near a face in the face database

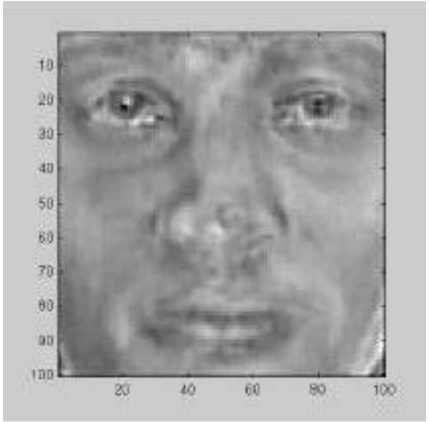
While it is possible to find the closest known face to the transformed image face by calculating the Euclidean distance to the other vectors, how does one know whether the image that is being transformed actually contains a face? Since PCA is a many-to-one transform, several vectors in the image space (images) will map to a point in face space (the problem is that even non-face images may transform near a known face image's faces space vector). Turk and Pentland (1991a), described a simple way of checking whether an image is actually of a face. This is by transforming an image into face space and then transforming it back (reconstructing) into image space. Using the previous notation,

$$I' = U^T * U * (I - A$$

With these calculations it is possible to verify that an image is of a face and recognise that face. O'Toole et al. (1993) did some interesting work on the importance of eigen faces with large and small eigenvalues. They showed that the eigen vectors with larger eigenvalues convey information relative to the basic shape and structure of the faces. This kind of information is most useful in categorising faces according to sex, race etc. Eigen vectors with smaller eigenvalues tend to capture information that is specific to single or small subsets of learned faces and are useful for distinguishing a particular face from any other face. Turk and Pentland (1991a) showed that about 40 eigen faces were sufficient for a very good description of human faces since the reconstructed image have only about 2% RMS. pixel-by-pixel errors.



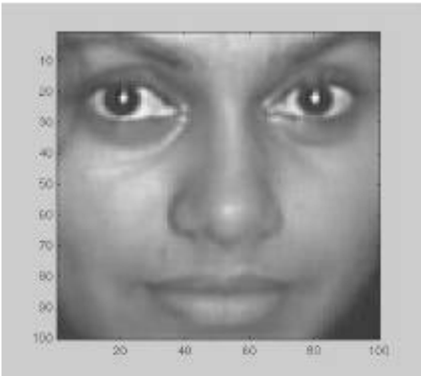
0.8235
0.0661
-0.8786
-0.4727
-0.0646
0.6642
-0.4840
-0.4501
-0.2506
0.1591
0.3359
0.0048
0.0745
………..



Hippo in image space

Hippo in face space

Reconstructed hippo in image space



0.7253
-0.0392
0.2896
-0.1725
-0.2642
-0.0014
-0.0814
-0.0054
-0.0623
-0.0965
-0.0879
0.0745
-0.0261
…………

Face in image space

Face in face space

Reconstructed face in image space

CONCLUSION

It can be concluded that a reliable, secure, fast and an efficient class attendance management system has been developed replacing a manual and unreliable system. This face detection and recognition system will save time, reduce the amount of work done by the administration and replace the stationery material currently in use with already existent electronic equipment.

There is no need for specialized hardware for installing the system as it only uses a computer and a camera. The camera plays a crucial role in the working of the system hence the image quality and performance of the camera in real time scenario must be tested especially if the system is operated from a live camera feed.

The system can also be used in permission based systems and secure access authentication (restricted facilities) for access management, home video surveillance systems for personal security or law enforcement.

The major threat to the system is Spoofing. For future enhancements, anti- spoofing techniques like eye blink detection could be utilized to differentiate live from static images in the case where face detection is made from captured images from the classroom. From the overall efficiency of the system i.e. 83.1% human intervention could be called upon to make the system foolproof. A module could thus be included which lists all the unidentified faces and the lecturer is able to manually correct them.

Future work could also include adding several well-structured attendance registers for each class and the capability to generate monthly attendance reports and automatically email them to the appropriate staff for review.

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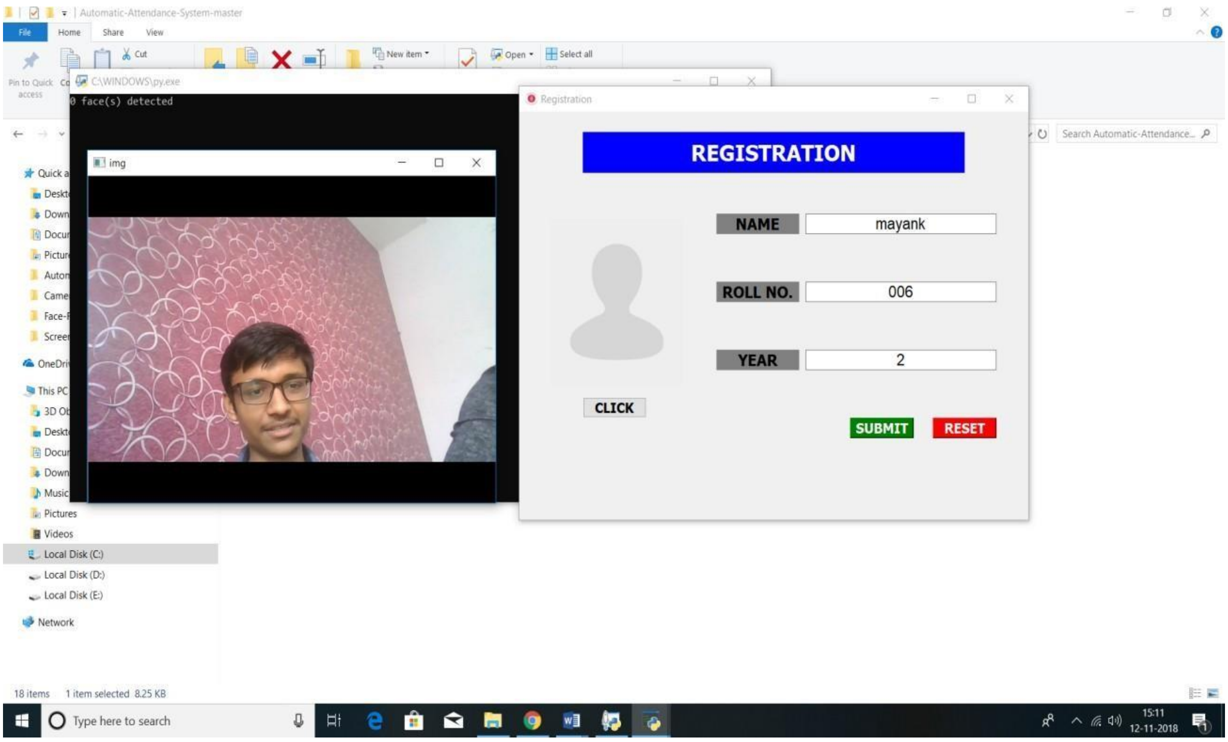
Registration
REGISTRATION
NAME
mayank
ROLL NO.
006
YEAR
2
CLICK
SUBMIT
RESET
img
0 face(s) detected
C:\WINDOWS\py.exe
Automatic-Attendance-System-master


Viola
Jones
Schneiderman
Kanade
CSE 576, Spring 2008
57