Project
Face Recognition (PCA)

Index

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I.INTRODUCTION

As we know we have approached 8 billion human in the surface of the earth and we are still increasing and increasing, So we have to find another way to identify people than their identity card, cause there are more than 200 country on the earth, each with different identification system which is kind of annoying and wasting of time while traveling.

But one simple idea can change that the work, every skin texture carries a data which we can easily analysis and detect some known patterns that identifies parts in our skin texture by comparing it to the other patterns this is known as (Face recognition).

Real time face recognition is part of the field of biometrics. Biometrics is the ability for a computer to recognize a human through a unique physical trait. Face recognition provides the capability for the computer to recognize a human by facial characteristics. Today, biometrics is one of the fastest growing fields in advanced technology. Predictions indicate a biometrics explosion in the next century, to authenticate identities and avoid and unauthorized access to networks, database and facilities. [1]

The science of automatic face recognition is studied for its importance in many fields it is a more improved system than the fingerprint recognition system it has been found even in cases of facial similarity (case of twins) their face print do not match with each other . Here we present the motivations to study the face recognition in the social field, political field, military field, and the field of protection for companies and important buildings. [4]

I.1. Motivation

1. Motivations to study face recognition in the social field and the political field

First in the social field. It's very important so face recognition is used as a mean to ensure that employees are present at work in the hours claimed. Where computers scan staff faces and compare them with images in the database and fill the records of absence, attendance, delay and early departure automatically from matching images to the database. Second in the political field. It is very important so many countries like (Mexican) use it to prevent the election fraud [2] by identifying voters
by their faces . The voters have data and images recorded in the database. The images in the database are compared with those of the people who want to vote and determine whether the voter voted before or did not vote to prevent fraud in elections. [3]

2. Motivation of the study face recognition in the field of protection for companies and important buildings

It has great importance in the field of protection and insurance for companies and important buildings and banks.
Used for identification using physiological properties.
Gender classification and age evaluation for each person in an image.
Live face detection prevents cheating with a photo in front of a camera. [3]

3. Motivation of the study face recognition in military field

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⇨ Protect bases and sensitive areas and highly secured areas.
⇨ Face recognition for military:-
1- Biometric surveillance for troops and Bases:
Face recognition technology eclipses traditional video surveillance in effectiveness and efficiency.
2- Mobile solutions

3- Proven effectiveness
Face first is used by military and law enforcement organizations worldwide to prevent terrorism, espionage and unauthorized access to sensitive areas and highly secured bases.

4- Overcome language barriers.
No translator available? No problem, face first photos confirm identity in seconds.
⇨ Face recognition for military troops and bases:-
Face first helps safeguard troops and sensitive military installations and highly secured bases through enterprise facial recognition software. [5]

⇨ Use a facial recognition technique to identify masked protesters.

I.2. Defined problems

1. Illumination

For example, a slight change in lighting conditions has always been known to cause a major impact on its results. If the illumination tends to vary, then; even if the same individual gets captured with the same sensor and with an almost identical facial expression, the results that emerge may appear quite different [6, 8].

2. Background

The placement of the subject also serves as a significant contributor to the indicators. A facial recognition system might not produce the same results outdoors compared to what it produces indoors because the factors - impacting its performance - change as soon as the locations change [12,13].

3. Pose

Facial Recognition Systems are highly sensitive to pose variations. The movements of head or differing point of view of a camera can invariably cause changes in face appearance and generate intra-class variations making automated face recognition across pose a tough nut to crack [15,16].

4. Occlusion

Occlusions of the face such as beard, moustache, accessories (goggles, caps, mask etc.) also meddle with the evaluation of a face recognition system [21]. Presence of such components makes the subject diverse and hence it becomes difficult for the system to operate in a non-simulated environment.

5. Expressions

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Another challenge to the facial recognition is the expression robust recognition. The facial expression identification is another application of facial recognition [21]. But if the expression of database image and the input image are different then it becomes difficult to perform the recognition.

6. Aging

One of the core challenge for facial recognition is the change is person face according to age. It means, the database image that provided the true recognition today may be not provide the same recognition rate after 5 years or 10 years [23] . Because of this, it is required to cover the aging vector in the authentication system.

I.3. Summary of Approach

1. Illumination

To overcome this problem we use Heuristic approaches [7], Image comparison approaches [8], Class-based approaches [9, 10] and Model-based approaches [11].

2. Background

To overcome this problem we use a robust algorithms or robust face recognition system [14]

3. Pose

To overcome this problem we use Multi image based approaches [17], Hybrid approaches [18, 19], Single image-shape based approaches [20].

4. Expressions

The expression independent facial recognition requires a robust and probabilistic model to provide the recognition [22].

5. Aging

To cover this, there is the requirement to update the dataset regularly. There also exist some robust recognition systems that can perform the age estimation [24] as well as provide the recognition along with age variation. The aging problem is critical and based on the probabilistic estimation so that the system which is not age adaptive cannot provide the accurate results.

I.4.Report Overview

Face recognition

At first, we will give you an introduction for the project and how it appears.

*Then we will start in ***THE MOTIVATAION*** that included:

1-Motivations to study face recognition in the social field and the political field

2-Motivation of the study face recognition in the field of protection for companies and important building

3-Motivation of the study face recognition in military field

*After that we will represent ***THE DEFINED PROBLEMS*** included:

1- Illumination
2- Background
3- Pose
4- Occlusion
5- Expression
6- Aging

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*Then ***THE SUMMARY OF APPROCHES*** included:

1- Illumination
2- Background
3- Pose
4- Expression
5- Aging

*Then we will represent **THE LITERATURE SURVEY** and the history of face recognition included the people how worked in it ….

THE BACKGROUND

1- Pixels
2- RGB color model
3- Black and white
4- Grayscale
5- PCA
6- Eigen vectors, Eigen values and Eigen faces
7- Covariance matrices
8- ROC curve
9- Sum Squared Distance
10- Equal error rate

*Then we will show **THE SYSTEM DESCRIPTION**
After that we will show **THE RESULTS**
We made the test on 10 persons of read images then we made test on 40 persons of read images and made test of 40 persons of unread images and get out the accuracy of the program for every condition and get out the whole accuracy
Then we will show **THE CONCLUSION** that included

- Motivations to study face recognition in the social field and the political field.
- - Motivation to study face recognition in the field of protection for companies and important buildings.
- - Motivation of the study faces recognition in military field.

Then we will show **THE FUTURE WORK** that included:

- Emotion
- Age Detection

At the End ... We finish our report with; ***REFRENCES***

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II. Literature Survey

Pioneers of automated face recognition include Woody Bledsoe, Helen Chan Wolf, and Charles Bisson.

During 1964 and 1965, Bledsoe, along with Helen Chan and Charles Bisson, worked on using the computer to recognize human faces (Bledsoe 1966a, 1966b; Bledsoe and Chan 1965). He was proud of this work, but because the funding was provided by an unnamed intelligence agency that did not allow much publicity, little of the work was published.[44] Based on the available references, it was revealed that the Bledsoe's initial approach involved the manual marketing of various landmarks on the face such as the eye centers, mouth, etc., and these were mathematically rotated by computer to compensate for pose variation.[44] The distances between landmarks were also automatically computed and compared between images to determine identity.[44]

Given a large database of images (in effect, a book of mug shots) and a photograph, the problem was to select from the database a small set of records such that one of the image records matched the photograph. The success of the method could be measured in terms of the ratio of the answer list to the number of records in the database. Bledsoe (1966a) described the following difficulties:

> “ This recognition problem is made difficult by the great variability in head rotation and tilt, lighting intensity and angle, facial expression, aging, etc. Some other attempts at face recognition by machine have allowed for little or no variability in these quantities. Yet the method of correlation (or pattern matching) of unprocessed optical data, which is often used by some researchers, is certain to fail in cases where the variability is great. In particular, the correlation is very low between two pictures of the same person with two different head rotations. ”
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> — *Woody Bledsoe, 1966*

This project was labeled man-machine because the human extracted the coordinates of a set of features from the photographs, which were then used by the computer for recognition. Using a graphics tablet (GRAFACON or RAND TABLET), the operator would extract the coordinates of features such as the center of pupils, the inside corner of eyes, the outside corner of eyes, point of widows peak, and so on. From these coordinates, a list of 20 distances, such as width of mouth and width of eyes, pupil to pupil, were computed. These operators could process about 40 pictures an hour. When building the database, the name of the person in the photograph was associated with the list of computed distances and stored in the computer. In the recognition phase, the set of distances was compared with the corresponding distance for each photograph, yielding a distance between the photograph and the database record. The closest records are returned.

Because it is unlikely that any two pictures would match in head rotation, lean, tilt, and scale (distance from the camera), each set of distances is normalized to represent the face in a frontal orientation. To accomplish this normalization, the program first tries to determine the tilt, the lean, and the rotation. Then, using these angles, the computer undoes the effect of these transformations on the computed distances. To compute these

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angles, the computer must know the three-dimensional geometry of the head. Because the actual heads were unavailable, Bledsoe (1964) used a standard head derived from measurements on seven heads.

After Bledsoe left PRI in 1966, this work was continued at the Stanford Research Institute, primarily by Peter Hart. In experiments performed on a database of over 2000 photographs, the computer consistently outperformed humans when presented with the same recognition tasks (Bledsoe 1968). Peter Hart (1996) enthusiastically recalled the project with the exclamation, "It really worked!"

By about 1997, the system developed by Christoph von der Malsburg and graduate students of the University of Bochum in Germany and the University of Southern California in the United States outperformed most systems with those of Massachusetts Institute of Technology and the University of Maryland rated next. The Bochum system was developed through funding by the United States Army Research Laboratory. The software was sold as ZN-Face and used by customers such as Deutsche Bank and operators of airports and other busy locations. The software was "robust enough to make identifications from less-than-perfect face views. It can also often see through such impediments to identification as mustaches, beards, changed hair styles and glasses—even sunglasses".[45]

In 2006, the performances of the latest face recognition algorithms were evaluated in the Face Recognition Grand Challenge (FRGC). High-resolution face images, 3-D face scans, and iris images were used in the tests. The results indicated that the new algorithms are 10 times more accurate than the face recognition algorithms of 2002 and 100 times more accurate than those of 1995. Some of the algorithms were able to outperform human participants in recognizing faces and could uniquely identify identical twins.[46][47]

U.S. Government-sponsored evaluations and challenge problems [48] have helped spur over two orders-of-magnitude in face-recognition system performance. Since 1993, the error rate of automatic face-recognition systems has decreased by a factor of 272. The reduction applies to systems that match people with face images captured in studio or mugshot environments. In Moore's law terms, the error rate decreased by one-half every two years.[49]

Low-resolution images of faces can be enhanced using face hallucination.

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III. Necessary Background

1. PIXEL

The word pixel is a portmanteau of pix (from "picture", shortened to "pic") and el (for "element")

In digital imaging, a pixel , or picture element [25] is a physical point in a raster image, or the smallest addressable element in an all points addressable display device; so it is the smallest controllable element of a picture represented on the screen.

Each pixel is a sample of an original image; more samples typically provide more accurate representations of the original. The intensity of each pixel is variable. In color imaging systems, a color is typically represented by three or four component intensities such as red, green, and blue (RGB), or cyan, magenta, yellow, and black(CMYK).

2. RGB color model

The RGB color model is an additive color model in which red, green and blue light are added together in various ways to reproduce a broad array of colors. The name of the model comes from the initials of the three additive primary colors, red, green, and blue (on a large color triangle [26]).

The main purpose of the RGB color model is for the sensing, representation and display of images in electronic systems, such as televisions and computers,

Each color (red, green, blue) has 256-degree where we start from 0 to 255 , example in the Digital 8-bit per channel: red is rgb(255,0,0) , magenta is rgb(255,0,255), white is rgb(255, 255, 255) , black is rgb(0, 0, 0) etc… for other Notations..

Notation	RGB triplet
Arithmetic	(1.0, 0.0, 0.0)
Percentage	(100%, 0%, 0%)
Digital 8-bit per channel	(255, 0, 0) or sometimes #FF0000 (hexadecimal)
Digital 12-bit per channel	(4095, 0, 0)
Digital 16-bit per channel	(65535, 0, 0)
Digital 24-bit per channel	(16777215, 0, 0)
Digital 32-bit per channel	(4294967295, 0, 0)

Each code or color represents a pixel in the digital image. So the maximum number or pixels is 16 777 216 color (pixel)

3. Black and white

Black-and-white (B/W or B&W) images combine black and white in a continuous spectrum, producing a range of shades of gray

4. Grayscale

In photography, computing, and colorimetry, a grayscale or grayscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Images of this sort, also known as black-and-white or gray monochrome, are composed exclusively of shades of gray. The contrast ranges from black at the weakest intensity to white at the strongest [27].

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Grayscale images are distinct from one-bit bi-tonal black-and-white images which, in the context of computer imaging, are images with only two colors: black and white (also called bilevel or binary images). Grayscale images have many shades of gray in between.

Grayscale images can be the result of measuring the intensity of light at each pixel according to a particular weighted combination of frequencies (or wavelengths), and in such cases they are monochromatic proper when only a single frequency (in practice, a narrow band of frequencies) is captured. The frequencies can in principle be from anywhere in the electromagnetic spectrum (e.g. infrared, visible light, ultraviolet, etc.).

A colorimetric (or more specifically photometric) grayscale image is an image that has a defined grayscale colorspace, which maps the stored numeric sample values to the achromatic channel of a standard colorspace, which itself is based on measured properties of human vision.

If the original color image has no defined colorspace, or if the grayscale image is not intended to have the same human-perceived achromatic intensity as the color image, then there is no unique mapping from such a color image to a grayscale image

Colorimetric (perceptual luminance-preserving) conversion to grayscale

A common strategy is to use the principles of photometry or, more broadly, colorimetry to calculate the grayscale values (in the target grayscale colorspace) so as to have the same luminance (technically relative luminance) as the original color image (according to its colorspace) .[28,29] In addition to the same (relative) luminance, this method also ensures that both images will have the same absolute luminance when displayed, as can be measured by instruments in its SI units of candelas per square meter, in any given area of the image, given equal whitepoints. Luminance itself is defined using a standard model of human vision, so preserving the luminance in the grayscale image also preserves other perceptual lightness measures, such as L^* (as in the 1976 CIE Lab color space) which is determined by the linear luminance Y itself (as in the CIE 1931 XYZ color space) which we will refer to here as Y_{linear} To convert a color from a colorspace based on a typical gamma-compressed (nonlinear) RGB color model to a grayscale representation of its luminance, the gamma compression function must first be removed via gamma expansion (linearization) to transform the image to a linear RGB colorspace, so that the appropriate weighted sum can be applied to the linear color components $R_{\mathrm{linear}}, G_{\mathrm{linear}}, B_{\mathrm{linear}}$ to calculate the linear luminance Y_{linear}, which can then be gamma-compressed back again if the grayscale result is also to be encoded and stored in a typical nonlinear colors pace.

Methods are:

$$Y_{\mathrm{linear}} = 0.2126R_{\mathrm{linear}} + 0.7152G_{\mathrm{linear}} + 0.0722B_{\mathrm{linear}}$$ [30]

$$Y' = 0.299R' + 0.587G' + 0.114B'$$

$$Y' = 0.2627R' + 0.6780G' + 0.0593B'$$

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5. PCA

This research is talking about eigenvalues, eigenvectors, Eigen faces, and covariance matrix. These are the most famous components in PCA algorithm. And it is important to the success of PCA algorithm.

First we will talk about eigenvectors. Before talking about eigenvectors, we first have to recognize what is the transformation matrix. As we know we can multiply two matrices provided they are equal in dimensions, and we can also multiply vector and matrix look to the next example [37]

$$\begin{pmatrix} 2 & 3 \\ 2 & 1 \end{pmatrix} * \begin{pmatrix} 3 \\ 2 \end{pmatrix} = \begin{pmatrix} 12 \\ 8 \end{pmatrix} = 4 * \begin{pmatrix} 3 \\ 2 \end{pmatrix}$$

(Figure 1 eigenvector and eigenvalue)

Let we have a vector in two dimensional space (3, 2). This vector represented as an arrow pointing from the origin (0, 0) to the vector's point (2, 3). The other matrix is thought to be the transformation matrix, that when multiply in any left vector, the output is another vector that is transformed from its original position. This is the transformation that produces the eigenvector [37]. Let's say we have a transformation matrix when you multiply it in any vector from the left, it reflects it around the line Y=X. From here you can see that if there is a vector represented on the line Y = X it will reflect itself and its place will not change. This vector and all multiples of it (because the length of the vector does not matter) is an eigenvector to the transformation matrix [37].

Second we will talk about eigenvalues. In the previous example we got an eigenvalues. After multiplication by the square matrix we got a scalar value [34] [37]. This value is the eigenvalue associated with the eigenvector. So we can see that the eigenvalues and the eigenvectors always come in pairs [37]. Note that it does not matter what multiples of the eigenvector are multiplied by the transformation matrix. In the end the eigenvalue will be 4[37]

Third we will talk about the Eigen faces. Eigen faces is the name given to a set of eigenvectors when used in a computer in the problem of face recognition [31]. The Eigen faces have been developed by (Sirovich and Kirby), and used by (Turk and Pentland) [32]. Eigen faces form a set of the images used to build the covariance matrix this reduces dimensions by representing original training images with a smaller set of images.

PCA can be used to form a set of basic features from a collection of faces images these basic features is the Eigen faces (Eigen pictures). These Eigen faces can be combined to re-create the training set. If the training set consists of M image the PCA function is in making it a picture set consisting of N image (Eigen faces) where N < M . Reconstruction error reduce by increasing Eigen faces but in all cases the number of Eigen faces does not exceed the number of original images in the training set [33] .

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Now an important question must be asked what makes the Eigen faces approach better than any other similar approach.
It can capture variation in a set of faces images and use this information to compare images unlike other approaches that seek to define facial features only (33).

Their motivations to use Eigen face such:-

1- Extract facial information that may or may not be related to human discrimination of facial features such as eyes, nose, etc. . . . One of the most important ways to do this is to extract the variation between facial images (33).

2- Represent faces images efficiently to reduce computing and complexity. To increase efficiency, each image can be represented with fewer information which in the original images (33).

Now the Eigen faces method has been expanded to include processing methods to improve image quality before reading it (34). And many methods have been used to construct Eigen faces sets with different information and features (35) (36).

Finally we will talk about the covariance matrices.

Definition
Throughout this part, boldfaced
Subscripted X and Y are used to refer to random vectors, and unboldfaced subscripted Xi and Yi are used to refer to scalar random variables.
If the entries in the column vector x = x1

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xn

Generalization of the variance (38)
The definition above is equivalent to the matrix equality
Σ = E [(X − E [X]) (X − E [X]) T] . {\displaystyle \Sigma =\operatorname {E} \left[(\mathbf {X} -\operatorname {E} [\mathbf {X}])(\mathbf {X} -\operatorname {E} [\mathbf {X}])^{\rm {T}}\right].}
This form can be seen as a generalization of the scalar-valued <u>variance</u> to higher dimensions. Recall that for a scalar-valued random variable X
σ 2 = var (X) = E [(X − E (X)) 2] = E [(X − E (X)) · (X − E (X))] . {\displaystyle \sigma ^{2}=\operatorname {var} (X)=\operatorname {E} [(X-\operatorname {E} (X))^{2}]=\operatorname {E} [(X-\operatorname {E} (X))\cdot (X-\operatorname {E} (X))].}
Indeed, the entries on the diagonal of the covariance matrix Σ {\displaystyle \Sigma}
are the variances of each element of the vector X {\displaystyle \mathbf

Properties

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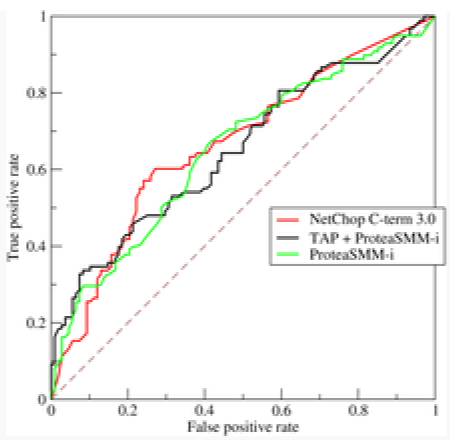
Basic properties
For Σ =var (X) = E[(X – E[X]) (X- E[X]) ^T]
and μ =E(X)
, where X
is a
- Dimensional random variable, the following basic properties apply (38)
1.
Σ = E(X(X^T)) - μ (μ^T)
2. Σ
is positive-semi definite and symmetric
3.
Var (AX+ a) = A var(X)(A^T)
4. If Y
is another random vector with the same dimension as
, then var(X+Y) = var(X) +cov(X , Y) + cov(Y , X) + var(Y)
where a
is a p*1
constant vector,
is a p*p
matrix of constants, and cov(X,Y)
is the cross-covariance matrix of X
and Y

6. Receiver Operating Characteristic



ROC curve of three predictors of peptide cleaving in the proteasome.

A receiver operating characteristic curve, i.e., ROC curve, is a graphical plot that illustrates the diagnostic ability of a binary classifier system as its discrimination threshold is varied.

The ROC curve is created by plotting the true positive rate (TPR) against the false positive rate (FPR) at various threshold settings. The true-positive rate is also known as sensitivity, recall or probability of detection[39] in machine learning. The false-positive rate is also known as the fall-out or probability of false alarm[39] and can be calculated as

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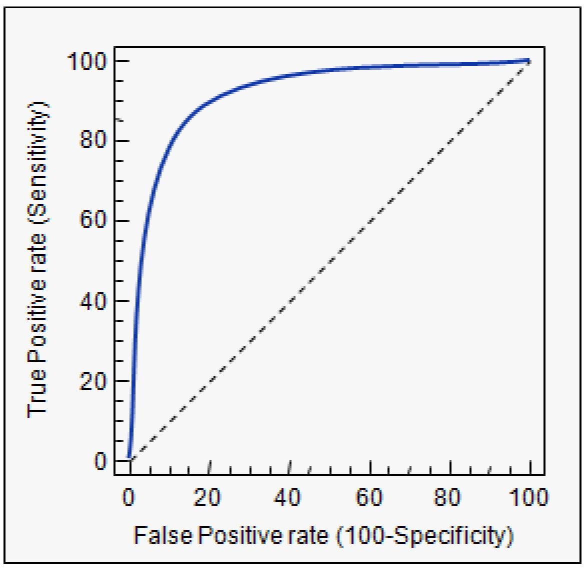
(1 – specificity). It can also be thought of as a plot of the Power as a function of the Type I Error of the decision rule (when the performance is calculated from just a sample of the population, it can be thought of as estimators of these quantities). The ROC curve is thus the sensitivity as a function of fall-out. In general, if the probability distributions for both detection and false alarm are known, the ROC curve can be generated by plotting the cumulative distribution function (area under the probability distribution from negative infinity to the discrimination threshold) of the detection probability in the y-axis versus the cumulative distribution function of the false-alarm probability on the x-axis.

ROC analysis provides tools to select possibly optimal models and to discard suboptimal ones independently from (and prior to specifying) the cost context or the class distribution. ROC analysis is related in a direct and natural way to cost/benefit analysis of diagnostic decision making.

The ROC curve was first developed by electrical engineers and radar engineers during World War II for detecting enemy objects in battlefields and was soon introduced to psychology to account for perceptual detection of stimuli. ROC analysis since then has been used in medicine, radiology, biometrics, forecasting of natural hazards,[40] meteorology,[41] model performance assessment,[42] and other areas for many decades and is increasingly used in learning and data mining research.

The ROC is also known as a relative operating characteristic curve, because it is a comparison of two operating characteristics (TPR and FPR) as the criterion changes.[43]



Precision is a description of random errors, a measure of statistical variability.

Accuracy has two definitions:

1. More commonly, it is a description of systematic errors, a measure of statistical bias; as these cause a difference between a result and a "true" value, ISO calls this trueness.
2. Alternatively, ISO defines accuracy as describing a combination of both types of observational error above (random and systematic), so high accuracy requires both high precision and high trueness.

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In simplest terms, given a set of data points from repeated measurements of the same quantity, the set can be said to be precise if the values are close to each other, while the set can be said to be accurate if their average is close to the true value of the quantity being measured. In the first, more common definition above, the two concepts are independent of each other, so a particular set of data can be said to be either accurate, or precise, or both, or neither.

7. Sum Squared Distance

It is an algorithm that compares the new picture you insert it as a matrix on the matlab or octave and reshape it and then find the most effective element to recognize this face from the data we inserted before and that with getting from the new matrix we made from comparing the new data with all the all data and taking the values that over 90% which means the elements that identify them easily like the color of eyes if there is any difference or the pattern that identify the face or any effective element and that with taking the new data and minus them from the old data then square them and that will give us the ability to identify the face quickly.

$$\begin{pmatrix} (Y_1-Y_2)^2 \\ (X_1-X_2)^2 \\ . \\ . \\ \ \end{pmatrix}$$

8. Equal Error Rate

We just saw that the ROC curve allows us to choose a "region" (a particular value of the threshold) where we want our classifier to "operate" and this choice is guided by the level of error that we are willing to tolerate in our systems. One major drawback of the metrics that we discussed in the first section is that they are all dependent on the threshold. There is obviously a need for a metric that does not depend on the threshold value so that we have a uniform basis for comparison across different classification systems. This is where the Equal Error Rate (EER) comes in. The EER is nothing but a special point along the ROC curve at a threshold value which has some nice properties.

As stated, in any binary classification set-up, there are two types of errors that we can make - false positives and false negatives. EER is basically the point on the ROC curve where the rates of both these two types of errors are the same i.e. FPR=FNRFPR=FNR. Using the result that we derived in the 1st section, this means that FPR= (1−TPR) FPR=(1−TPR) or TPR+FPR=1TPR+FPR=1.

This tells us that the EER is the value of FPR (X-axis) at the point where the ROC curve intersects the line x+y=1x+y=1.

The intuition behind defining the EER in such a fashion is so that we do not favour one type of error over another (which is inevitable if you think from an application perspective). Hope this helps!

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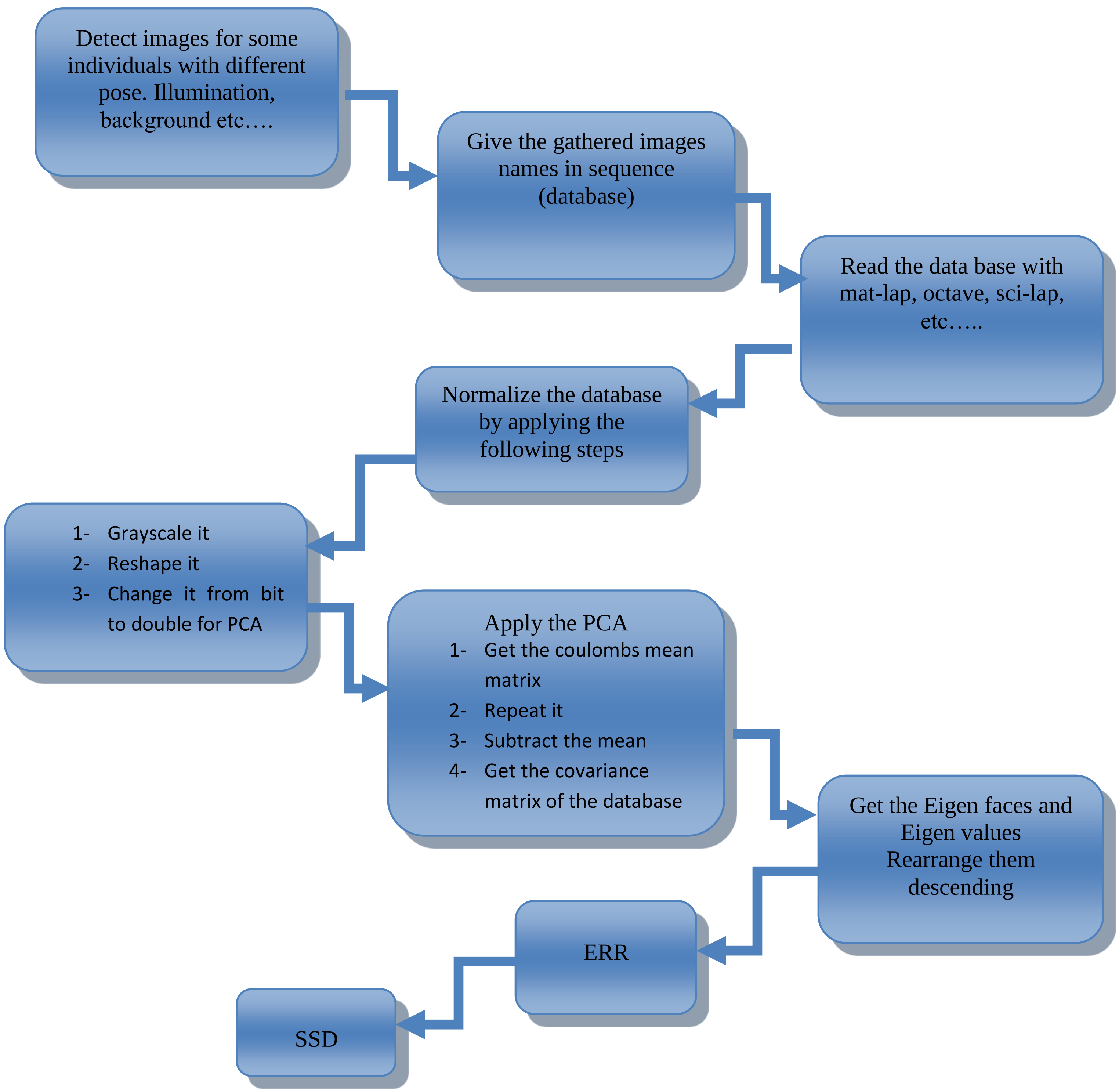
IV. System Description



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V. Results

At first we made the experiment on 10 persons... We read 4 images for every single person and made the test on other 3 images of the same persons... We found that the accuracy = 93.33%

Then we made the experiment on 40 persons... We read 4 images for every single person and made the test on other 3 images of the same persons... We found that the accuracy = 64.167%

After that we made the experiment on 40 persons from (1 to 40)...we read 4 images for every single person and made test on 3 images of other 40 persons from (41 to 80) to check if the program and the codes we made would say that the persons u just inserted to test (41 to 80) isn't at the threshold u put at first and they are different persons ... We found that the accuracy = 34.167%

So the whole accuracy of the program = 63.89%

VI. Conclusion And Future Work

1.Conclusion:-

At the end of the report. I would like to present the main points of it in order to be a quick summary of the report .we started with an introduction on which we talked about the subject in general. Second, we presented the motivations for studying the subject of recognition of the faces and within our presented:-

1- Motivations to study face recognition in the social field and the political field.

2- Motivation to study face recognition in the field of protection for companies and important buildings.

3- Motivation of the study faces recognition in military field.

Then we presented the definition of the problems that face the face recognition process and solutions to these problems such as (illumination , background , pose , occlusions , expressions , and aging) .forth we showed the report overview , then we presented the literature Survey with a historical overview of face recognition . then the necessary background in which we showed(pixels, RGB color mode, black and white, grayscale, PCA, eigenvectors, eigenvalues, eigenfaces, covariance matrices, ROC curve, sum squared distance, and equal error rate) . Then we presented the block diagram which describes the system. then the results we got according to the code of face recognition process in which we made the experiment on 10 persons at first and tested with 3 images of the same persons we found that the accuracy = 93.33% . Then we made the experiment on 40 persons and tested with 3 images of the same persons we found that the accuracy = 64.167%. Then we made the experiment on 40 persons and tested with 3 images of other 40 persons we found that the accuracy = 34.167%. So the whole accuracy of the program = 63.89%.

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Future work:-

Today, safety is one area where facial recognition is used. Face recognition is a very effective tool that can help law enforcement in realizing criminals and software companies working to take advantage of technology to help users reach their own needs. there are some ways in which the efficiency of face recognition can be increased such as :-

1- Emotion Detection
Emotion detection is a big step in the progress of face recognition . because it's not only possible to recognize the persons , but also interpret how they are feeling .

2-Age Detection
We can improve the face recognition system at determining people's age . and age detection algorithms can be useful in retail environment because it warns the sellers if someone is too young to buy certain products such as (Alcohol or Cigarettes)

VII. #Work#

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clear;
clc;
%reading_images%
k=1;
for i=1:40;
  for j=[5,10,12,14];
    if j<10
    B=strcat(int2str(i),'-0',int2str(j),'.jpg');
    r=imread(B);
    r=rgb2gray(r);
    r=double(r);
    y=reshape(r,[],1);
    z(:,k)=y;
    k=k+1;
  else
    B=strcat(int2str(i),'-',int2str(j),'.jpg');
    r=imread(B);
    r=rgb2gray(r);
    r=double(r);
    y=reshape(r,[],1);
    z(:,k)=y;
    k=k+1;
    endif
  endfor
endfor
```

.

```
%preparing_data%
m=mean(z,2);
[q,s]=size(z);
R=repmat(m,1,s);
a=z-R;
cov=a'*a;
[v,d]=eig(cov);
d=diag(d);
[s,y]=sort(d,'descend');
x=cumsum(s);
xs=sum(s);
x=(x./xs).*100;
w=find(x>90);
M=v(:,y(1:w(1)));
E=a*M;
EF=E'*a;
%testing%
I=imread('1-02.jpg');
r1=rgb2gray(I);
r1=double(r1);
r1=reshape(r1,[],1);
A = r1-m;
Wt = E'*A;
distance = sum((repmat(Wt,1,size(EF,2)) - EF).^2);
[V,I] = min(distance);
        if V <= 4.1251e+17
            G=ceil(I/4);
        else
            G=0;
        end
        if G == 1          %this value varies when u change the tested person for
example if u take person number 5 then G will equal 5
           disp('Correct');
        else
           disp('incorrect');
        end
```

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