A

Synopsis Report On

FACE RECOGNITION SYSTEM

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CERTIFICATE

This is to certify that

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ABSTRACT

Face (facial) recognition is the identification of humans by the unique characteristics of their Faces.Face recognition technology is the least intrusive and fastest bio-metric technology. It works with the most obvious individual identifier the human face. With increasing security needs and with advancement in technology extracting information has become much simpler. This project aims on building an application based on face recognition using different algorithms and comparing the results. The basic purpose being to identify the face and retrieving information stored in database. It involves two main steps. First to identify the distinguishing factors in image n storing them and Second step to compare it with the existing images and returning the data related to that image. The various algorithms used for face detection are PCA Algorithm and Gray Scale Algorithm.

Keywords : Face Recognition, PCA Algorithm, Gray Scale Algorithm, Eigenfaces.

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Chapter 1

1 Introduction

1.1 Biometrics

Biometrics is used in the process of authentication of a person by verifying or identifying that a user requesting a network resource is who he, she, or it claims to be, and vice versa. It uses the property that a human trait associated with a person itself like structure of data with the incoming data we can verify the identity of a particular person [1]. There are many types of biometric system like detection and recognition, iris recognition etc., these traits are used for human identication in surveillance system, criminal identification , face details etc. By comparing the existing fingerprint recognition.

1.2 Face Recognition

Human beings have recognition capabilities that are unparalleled in the modern computing era. These are mainly due to the high degree of interconnectivity, adaptive nature,learning skills and generalization capabilities of the nervous system. The human brain has numerous highly interconnected biological neurons which, on some specific tasks, can outperform super computers. A child can accurately identify a face, but for a computer it is a cumbersome task. Therefore, the main idea is to engineer a system which can emulate what a child can do. Advancements in computing capability over the past few decades have enabled comparable recognition capabilities from such engineered systems quite successfully. Early face recognition algorithms used simple geometric models, but recently the recognition process has now matured into a science of sophisticated mathematical representations and matching processes. Major advancements and initiatives have propelled face recognition technology into the spotlight. Face recognition technology can be used in wide range of applications.Computers that detect and recognize faces could be applied to a wide variety of practical applications including criminal identification etc. Face detection and recognition is used in many places nowadays,verifying websites hosting images and social networking sites. Face recognition and detection can be achieved using technologies related to computer science. Features extracted from a face are processed and compared with similarly processed faces present in the database. If a face is recognized it is known or the system may show a similar face existing in database else it is unknown. In surveillance system if a unknown face appears more than one time then it is stored in database for further recognition. These steps are very useful in criminal identification. In general, face recognition techniques can be divided into two groups based on the face representation they use appearance-based, which uses holistic texture features and is applied to either whole-face or specific face image and feature-based, which uses geometric facial features (mouth, eyebrows, cheeks etc), and geometric relationships between them. (A few example applications are shown in Fig 1.1.)

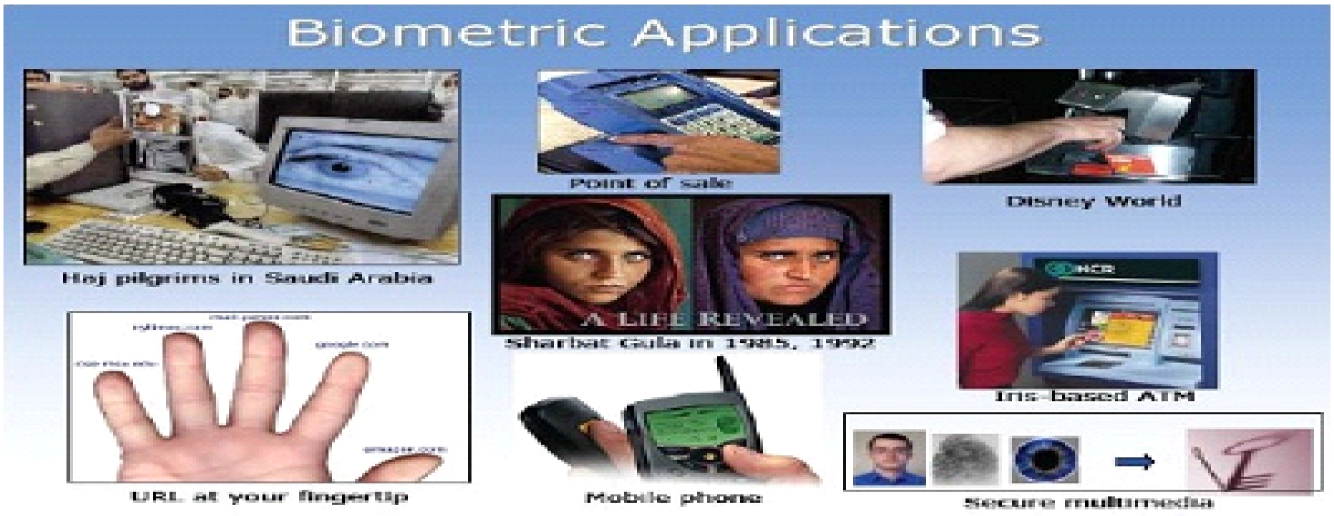

Figure 1: Biometric Applications

In Fig 1.1 An important aspect is that such technology should be able to deal with various changes in face images, like rotation, changes in expression. Surprisingly, the mathematical variations between the images of the same face due to illumination and viewing direction are almost always larger than image variations due to changes in face identity. This presents a great challenge to face recognition. At the core,two issues are central to successful face recognition algorithms: First, the choice of features used to represent a face. Since images are subject to changes in viewpoint, illumination, and expression, an effective representation should be able to deal with these possible changes.

Secondly, the classification of a new face image using the chosen representation. Face Recognition can be of two types:
Feature Based (Geometric)
Template Based (Photometric)

In geometric or feature-based methods, facial features such as eyes, nose, mouth, and chin are detected. Properties and relations such as areas, distances, and angles between the features are used as descriptors of faces. Although this class of methods is economical and efficient in achieving data reduction and is insensitive to variations in illumination and viewpoint, it relies heavily on the extraction and measurement of facial features. Unfortunately, feature extraction and measurement techniques and algorithms developed to date have not been reliable enough to cater to this need. In contrast, template matching and neural methods generally operate directly on an image-based representation of faces, i.e., pixel intensity array. Because the detection and measurement of geometric facial features are not required, this type of method has been more practical and easier to implement when compared to geometric feature-based methods.

Chapter 2

2 Problems and Objectives

The problem of face recognition can be stated as follows : Face Recognition human facial features like the mouth, nose and eyes in a full frontal face image. We will be adapting a multi-step process in order to achieve the goal. To detect the face region we will be using a skin-color segmentation method. Morphological techniques will be adapted to fill the holes that would be created after the segmentation process. From the skeletonization process, a skeleton of the face will be obtained from which face contour points could be extracted. Facial features can be located in the interior of the face contour. We will use several different facial-images to test our method.

2.1 Objectives

1. Trying to find a face within a large database of faces. In this approach the system returns a possible list of faces from the database. The most useful applications contain crowd surveillance, video content indexing, personal identification (example: drivers license), mug shots matching, etc.

2. Real time face recognition: Here, face recognition is used to identify a person on the spot and grant access to a building or a compound, thus avoiding security hassles. In this case the face is compared against a multiple training samples of a person.

Chapter 3

3 Literature Survey

Several algorithms and techniques for face recognition have been developed in the past by researchers.These are discussed briefly in this section.

3.1 Face Recognition Based on Independent Component Analysis:

A number of current face recognition algorithms use face representations found by unsupervised statistical methods. Typically these methods find a set of basis images and represent faces as a linear combination of those images. Principal component analysis (PCA) is a popular example of such methods. The basis images found by PCA depend only on pairwise relationships between pixels in the image database. In a task such as face recognition, in which important information may be contained in the high-order relationships among pixels, it seems reasonable to expect that better basis images may be found by methods sensitive to these high-order statistics. Independent component analysis (ICA), a generalization of PCA, is one such method. We used a version of ICA derived from the principle of optimal information transfer through sigmoidal neurons. ICA was performed on face images in the FERET database under two different architectures, one which treated the images as random variables and the pixels as outcomes, and a second which treated the pixels as random variables and the images as outcomes. The first architecture found spatially local basis images for the faces. The second architecture produced a factorial face code. Both ICA representations were superior to representations based on PCA for recognizing faces across days and changes in expression. A classifier that combined the two ICA representations gave the best performance.[1]

3.2 Eigen-spaces:

Eigenspace-based face recognition corresponds to one of the most successful methodologies for the computational recognition of faces in digital images. Starting with the Eigenface-Algorithm, different eigenspace-based approaches for the recognition of faces have been proposed. They differ mostly in the kind of projection method used (standard, differential, or kernel eigenspace), in the projection algorithm employed, in the use of simple or differential images before/after projection, and in the similarity matching criterion or classification method employed. The aim of this paper is to present an independent comparative study among some of the main eigenspace-based approaches. We believe that carrying out independent studies is relevant, since comparisons are normally performed using the implementations of the research groups that have proposed each method, which does not consider completely equal working conditions for the algorithms. Very often, a contest between the abilities of

the research groups rather than a comparison between methods is performed. This study considers theoretical aspects as well as simulations performed using the Yale Face Database, a database with few classes and several images per class, and FERET, a database with many classes and few images per class.[2]

3.3 Elastic bunch Graph Matching

Elastic Bunch Graph Matching is one of the well known methods proposed for face recognition. In this work, we propose several extensions to Elastic Bunch Graph Matching and its recent variant Landmark Model Matching. We used data from the FERET database for experimentations and to compare the proposed methods. We apply Particle Swarm Optimization to improve the face graph matching procedure in Elastic Bunch Graph Matching method and demonstrate its usefulness. Landmark Model Matching depends solely on Gabor wavelets for feature extraction to locate the landmarks (facial feature points). We show that improvements can be made by combining gray-level profiles with Gabor wavelet features for feature extraction. Furthermore, we achieve improved recognition rates by hybridizing Gabor wavelet with eigenface features found by Principal Component Analysis, which would provide information contained in the overall appearance of a face. We use Particle Swarm Optimization to fine tune the hybridization weights.[3]
Results of both fully automatic and partially automatic versions of all methods are presented. The best-performing method improves the recognition rate up to 22.6speeds up the processing time by 8 times over the Elastic Bunch Graph Matching for the fully automatic case.

3.4 Linear Discriminant Analysis

Both PCA and ICA do not use face class informa-tion. Linear Discriminant Analysis (LDA) finds an ecient way to represent the face vector space by exploiting the class information. It dierentiates individual faces but recognizes faces of the same individual].
LDA searches for vectors in the underlying space that best discriminate among classes. For all the samples of all classes, two measures are defined.

Chapter 4

4 Theory Methodology and Algorithm

The previous sections illustrate different techniques and methods of face detection and recognition. Each category of method performs well in certain criteria and also has drawbacks as well. Systems with robustness and certain level of accuracy are still far away. Keeping in view case study the following architecture is proposed for the detection and recognition system.

As discussed earlier that the robust system catering the needs of real world situation is a challenging task. The images will be scanned by scanner and stored into database. Again the image will be scanned and stored into the database. Now two images of the same candidate will be stored into the database. The first step is to select desired images from the database then for comparisons them the next step is to detect faces from each image. The next step is to recognize that images as of the same candidate or not.

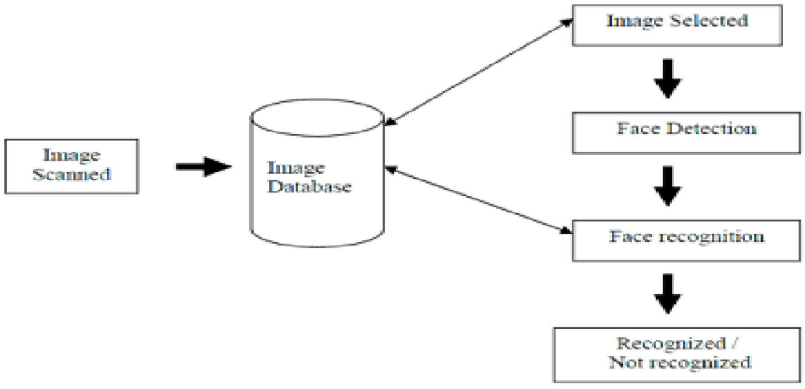

Figure 2: Structure of Face Recognition System

The pseudo-code for PCA is as follows:

1. Set image resolution parameter 4 (im_{res})
2. Set PCA dimensionality parameter (PCA_{DIM})
3. Read training images
4. Form training data matrix ($M_{train_{data}}$)
5. Form training class labels matrix ($M_{train_{labels}}$)
6. Calculate PCA transformation matrix (tmatrix)
7. Calculate feature vectors of all training images using tmatrix
8. Store training feature vectors in a matrix
9. Read test faces
10. For each test face do
11. Calculate the feature vector of a test face using t matrix
12. Compute the distances between test feature vector and all training vectors
13. Store the distances together with the training class labels
14. Initialize error count to zero.
15. For each test face do
16. Using the distance data, determine the person ID of the most similar training vector
17. If the found ID is not equal to the ID of the test image increment error count
18. Output the correct recognition accuracy :

(1 - (error count/ total test image count))*100

Chapter 5

5 Plan of Work and Project Status

5.1 Proposed Module

Face Recognition using PCA and Grayscale algorithms. In our project we are going to compare these two methods of face detection and find their difference using constant tests and analysis.

5.2 Scheduling

The following table shows the expected flow of work for the accomplishment of the required result.

Table 5.1 : Plan of work

No.	Description	Duration	Complexity
1	Literature Survey of basics of Face Recognition	1 week	5
2	Literature Survey of various methods available for face recognition	2 weeks	5
3	Literature Survey on Face Recognition from practical point of view	2 weeks	5
4	Coding: Java	1 week	5
5	Literature Survey: Using PCA Algorithm and GrayScale Algorithm	1 week	5

Chapter 6

6 Summary

Face recognition systems are useful in law enforcement and justice solutions by staying one step ahead of the world's ever-advancing criminals. This includes acclaimed CABS-computerized arrest and booking system and the childbase protection which is a software solution for global law enforcement agencies to help protect and recover missing and sexually exploited children, particularly as it relates to child pornography. It is also useful in Homeland defense which includes everything from preventing terrorists from boarding aircraft, to protecting critical infrastructure from attack or tampering (e.g. dams, bridges, water reservoirs, energy plants, etc.), to the identification of known terrorists. It is also applicable in airport and other transportation terminal security. Face recognition software, can enhance the effectiveness of immigration and customs personnel. The financial services industry revolves around the concept of security. Face recognition software, can improve the security of the financial services industry, saving the institution time and money both through a reduction of fraud case and the administration expenses of dealing with forgotten passwords. Furthermore, biometric-based access control units can safeguard vaults, teller areas, and safety deposit boxes to protect against theft. The use of biometrics can also ensure that confidential information remains confidential while deterring identity theft, particularly as it relates to ATM terminals and card-not-present e-commerce transactions. It allows capturing, archiving, and retrieving identifying characteristics as tattoos, marks, or scars. It can also analyze scenes from either streaming or archived video, "looking" for out-of-the-ordinary occurrences, the presence of certain vehicles, specific faces, etc. This is beneficial and can save significant time and money to those individuals who spend hours, days, or weeks monitoring video streams (i.e. examining a bank's security in a criminal investigation).

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8 Apeendix A

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