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Image Processing in Face Recognition Using ML

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BONAFIDE CERTIFICATE

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CHAPTER-I

Abstract

The face is one of the easiest ways to distinguish the individual identity of each other. Face recognition is a personal identification system that uses personal characteristics of a person to identify the person's identity. Human face recognition procedure basically consists of two phases, namely face detection, where this process takes place very rapidly in humans, except under conditions where the object is located at a short distance away, the next is the introduction, which recognize a face as individuals. Stage is then replicated and developed as a model for facial image recognition (face recognition) is one of the much-studied biometrics technology and developed by experts. There are two kinds of methods that are currently popular in developed face recognition pattern namely, Eigenface method and Fisher face method. Facial image recognition Eigenface method is based on the reduction of face dimensional space using Principal Component Analysis (PCA) for facial features. The main purpose of the use of PCA on face recognition using Eigen faces was formed (face space) by finding the eigenvector corresponding to the largest eigenvalue of the face image. The area of this project face detection system with face recognition is Image processing. The software requirements for this project is MATLAB software.

Keywords: face detection, Eigen face, PCA, MATLAB

Extension: There are vast number of applications from this face detection project, this project can be extended that the various parts in the face can be detect which are in various directions and shapes.

CHAPTER-II

Introduction

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

Face is most commonly used biometric to recognize people. Face recognition has received substantial attention from researchers due to human activities found in various applications of security like airport, criminal detection, face tracking, forensic etc. Compared to other biometric traits like palm print, Iris, finger print etc., face biometrics can be non-intrusive. They can be taken even without user's knowledge and further can be used for security-based applications like criminal detection, face tracking, airport security, and forensic surveillance systems. Face recognition involves capturing face image from a video or from a surveillance camera. They are compared with the stored database. Face biometrics involves training known images, classify them with known classes and then they are stored in the database. When a test image is given to the system it is classified and compared with stored database. Face biometrics is a challenging field of research with various limitations imposed for a machine face recognition like variations in head pose, change in illumination, facial. expression, aging, occlusion due to accessories etc. Various approaches were suggested by researchers in overcoming the limitations stated. 72 Automatic face recognition involves face detection, feature extraction and face recognition. Face recognition algorithms are broadly classified into two classes as image template based and geometric feature based. The template-based methods compute correlation between face and one or more model templates to find the face identity. Principal component analysis, linear discriminate analysis, kernel methods etc. are used to construct face templates. The geometric feature-based methods are used to analyse explicit local features and their geometric relations (elastic bung graph method). Multi resolution tools such as contour lets, ridge lets were found to be useful for analysing information content of images and found its application in image processing, pattern recognition, and computer vision. Curvelets transform is used for texture classification and image de-noising. Application of Curvelets transform for feature extraction in image processing is still under research.

2. FACE RECOGNITION SYSTEM

The face recognition system consists of four modules: face detection, face normalization, face feature extraction and matching the face recognition process can be operated in face verification,

face identification and face watch (tracking, surveillance). In face verification a query face image is compared against a template face image whose identity is being claimed. In face identification a query face image is compared against all templates in the database to 73 determine the claimed identity. In face tracking and surveillance, face images are tracked and compared with the stored databases.

2.1 FACE DETECTION

Face detection is the first stage in the identification process. Face detection is viewed as a two-class classification (face vs. non face). Detecting faces from an image, video tracking, may be subjected to various limitations such as illumination problem, pose variations, occlusions due to accessory etc. Various approaches like holistic/template, geometric based were used to address the limitations that are stated. The techniques used were able to resolve only few of the limitations. Using combination of techniques promising results were seen. Geometrical features of the face are extracted from eyes, shape of mouth, face boundary etc. and are organized as graph for modelling and recognition. The various face detection techniques are Principal Component Analysis (PCA), Neural Networks, Machine Learning, Geometrical Modelling, Hough Transform and Template Matching. is an integral part of face recognition. In face modelling, facial shape is integrated with distinctive facial features to give a realistic face model. Face modelling simplifies in describing the complexity of face geometry. The face modelling approaches includes elastic bunch graph, active appearance model (2D), 3D model etc. Earlier in the tabulating systems era (1900s — 1940s) and programming era (from 1950s), computer systems were only able to perform iterative, conditional and logical computations. However, with the advent of new technologies, such computing systems were developed which could learn without being explicitly programmed to perform specific task. Such technology is termed as Machine Learning where a machine or a system is able to learn from certain algorithms and make predictions on the basis of it.

FUNDAMENTAL STEPS IN IMAGE PROCESSING

Fundamental steps in image processing are

1. Image acquisition: to acquire a digital image

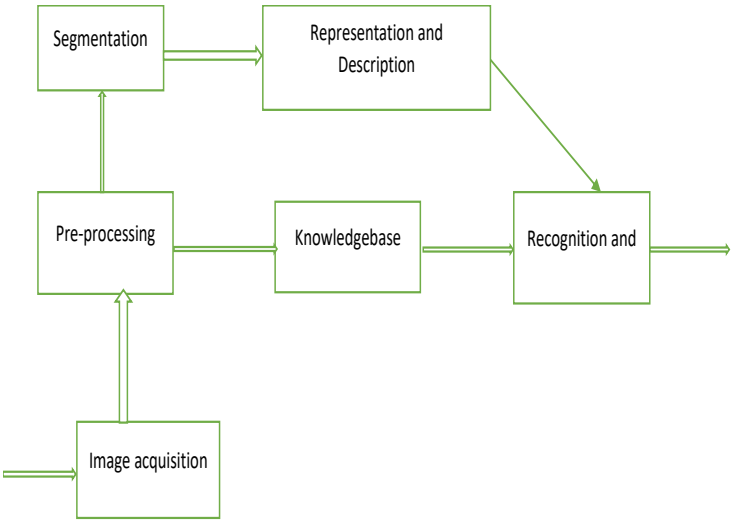
2. Image pre-processing: to improve the image in ways that increases the chances for success of the other processes.

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

4. Image 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.

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

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



FACE DETECTION 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.

2. Classification

Neural networks are implemented to classify the images as faces or non faces 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.

3.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.

FACE RECOGNIZATION

There are two predominant approaches to the face recognition problem: Geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many

different algorithms were developed, three of which have been well studied in face recognition literature.

Recognition algorithms can be divided into two main approaches:

1. Geometric

It 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.

2. Photometric

It is 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.

Types of image processing

1.Low 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.

2.Medium level processing

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.

3.High level processing

High level processing deals with adding of artificial intelligence to medium processed signal.

CHAPTER-III

EXISTING ALGORITHMS FOR FACE DETECTION AND RECOGNITION

Numerous robust algorithms have been developed and claimed to have accurate performance to tackle face detection and recognition problems. These algorithms or methods are the most successfully and widely used for face detection and recognition applications. The algorithms are as follow:

Principle Component Analysis (PCA)

a. Eigenface

Linear Discriminant Analysis (LDA)

a. Fisher face

Skin colour-based algorithm

a. Red-Green-Blue (RGB)

b. YCbCr (Luminance -Chrominance)

c. Hue-Saturation Intensity (HSI)

Wavelet based algorithm

a. Gabor Wavelet

Artificial neural networks-based algorithm

a. Fast Forward

b. Back Propagation

c. Radial Basis Function (RBF)

Principle Component Analysis (PCA)

PCA is a method in which is used to simplify the problem of choosing the representation of eigenvalues and corresponding eigenvectors to get a consistent representation. This can be achieved by diminishing the dimension space of the representation. In order to obtain fast and robust object recognition, the dimension space needs to be reduced. Moreover, PCA also retains the original information of the data. Eigenface based algorithm applies the PCA basis.

Eigenface based algorithm

Eigenface based approach is the most widely used method for face detection. According to Pavanet al., eigenface is well known due to its simplicity, less sensitive in poses and better performance involving small databases or training sets. This approach utilizes the presence of eyes, nose and mouth on a face and relative distances between these objects. This characteristic feature is known as Eigenfaces in facial domain This facial feature can be extracted by using a mathematical tool called Principle Component Analysis (PCA). By using PCA, any original image from the training set can be reconstructed by combining the Eigenfaces. Generally, a face is classified as a face by calculating the relative distance of the Eigenfaces.

Linear Discriminant Analysis (LDA)

LDA is also known as Fisher's Linear Discriminant (FLD). It reduces the dimension space by using the FLD technique. FLD technique utilizes within-class information, minimizing variation within each class and maximizing class separation.

Fisher face-based algorithm

The Fisher face approach is also one of the most widely used methods for feature extraction in face images. This approach tries to find the projection direction in which, images belonging to different classes are separated maximally According to Shang-Hung Lin, Fisher face algorithm is a refinement of the eigenface algorithm to cater the illumination variation Bulhumeur reported that Fisher face algorithm performs better than eigenface in a circumstance where the lighting condition is varied. This approach requires several training images for each face. Therefore, it cannot be applied to the face recognition applications where only one example image per person is available for training.

Skin colour-based algorithm

Skin colour is the most obvious and important features of human faces. Human skin colours are distinguished from different ethnic through the intensity of the skin colour not the chromatic features One of facial feature methods is involving skin colour-based processing method. According to Crowley and Coutaz one of the simplest algorithms for detecting skin pixels is to use skin colour algorithm. Each pixel is classified as skin colour and non-skin colour. This classification is based on its colour component, which is modelled by Gaussian probability density. For an input image, this method utilizes colour space for the skin region as the classification. Threshold is applied to mask the skin region. Finally, a bounding box is drawn to extract the face from the input image. Skin colour processing method offers a faster processing time than other facial feature methods and orientation invariant. However, Yeong Nam Chaeet al. has a diverse opinion whereby skin colour method is time consuming as it scans the target image linearly which involves a large space of scanning. Hence, they have proposed a novel method using sub-windows scanning instead of the conventional linear scanning. This proposed method works by scanning the image sparsely based the facial colour density by determining the horizontal and vertical intervals. From the experiment, the results reveal that this proposed method was successfully detects faces in a shorter period of time compared to the conventional method. The sub-windows scanning method contributes to the less computational time as it

skips the sub-windows that do not consist of possible faces. There are three most popular colour spaces, namely, the RGB, YCbCr and HSI.

RGB (Red-Green-Blue)

In RGB colour space, a normalized colour histogram is used to detect the pixels of skin colour of an image and can be further normalized for changes in intensity on dividing by luminance. This localizes and detects the face. However, this colour space is not preferable for colour-based detection methods compared to YCbCr or HIS. A survey that has been conducted al. reveals that RGB colour space tends to mix the chrominance and the luminance data, high correlation between channels and significant perceptual non-uniformity. These factors contribute to the less favourable of RGB.

YCbCr (Luminance-Chrominance)

This colour space provides a good coverage of different human races. The responsible values are luminance (Y) and chrominance (C). It involves a separation of luminance and chrominance. This algorithm can only be done if chrominance component is used. It will eliminate the luminance as much as possible by choosing the Cb-Cr plane from the YCbCr colour space. A pixel is determined as skin tone if the values [Cr, Cb] fall within the thresholds.

HSI (Hue-Saturation-Intensity)

Based on the studies done by Zaritet al. HIS deems to be yield the best performance for skin colour approach a skin region can be separated from the background by using a colour predicate in HSV colour space. Skin colour classification in HSI colour space is similar to YCbCr colour space but the responsible values are hue (H) and saturation (S). Unfortunately, all of these algorithms fail when there are regions other than face such as arms, legs and other objects in background that have the same colour value.

Wavelet based algorithm

In wavelet-based algorithm, each face image is described by a subset of band filtered images containing wavelet coefficients. Wavelet transform offers a likelihood of providing a robust multi scale way analysis of an image. Wavelets are also very flexible, whereby several bases exist and the most suitable basis can be chosen for an application. The most widely used wavelet method is the Gabor wavelet method especially in image texture analysis.

Gabor Wavelet

Gabor wavelet transform utilizes spatial frequency structures and orientation relation This method is a type of Gaussian modulated sinusoidal wave of the Fourier transform. Gabor wavelet approach works by detecting short lines, ending lines and sharp changes in curvature. These curves correspond well with the prominent features of human faces such as mouth, nose, eyebrow, jaw line and cheekbone as depicted in. Therefore, Gabor wavelet is very well known in feature detecting.

(a) mouth, (b) nose, (c) eyebrow, (d) jaw line and (e)cheekbone

Artificial neural networks-based algorithm

Artificial neural network (ANN) is mostly used as a method for recognition process. ANN will be implemented once a face has been detected to identify and recognize who the person is calculating the weight of the facial information.

CHAPTER-IV

PROPOSED FACE RECOGNITION SYSTEM

Face recognition is a visual pattern recognition problem. Face detection segments the face area from the background. Face recognition, as one of the primary biometric technologies, became more and more important owing to rapid advances in technologies such as digital cameras, internet and mobile devices, and increased demands on security. Face recognition has several advantages over other biometric technologies: It is natural, nonintrusive, and easy to use. The proposed research is carried out in the following manner using unimodal and multimodal biometric trait to identify the best approach for Multimodal Biometric Authentication System (MMBAS). ¾ Face detection system with a combination of Cryptographic techniques Message Digest (MD5) and Secure Hash Algorithm (SHA1) with Elastic Bunch Graph Matching (EBGM) algorithm ¾ Face recognition using Scale Invariant Feature Transform (SIFT) ¾ A combination of face and finger print authentication system using Bit Plane Complexity Segmentation (BPCS) method with steganography Many recent researches show that local features are more effective to describe the detailed and stable information of an image. Applications are in the real time environment to implement the recognition system, like E-trading, online 43 banking, E-voting or internet voting etc. But among these, the online remote voter registration systems face some critical security problems (Election Law Blog 2007). These problems are mainly related to the inability to accurately verify the identity of the voter, which can facilitate impersonation or multiple registrations by the same voter with different data. The proposed system takes this issue as an application domain and it introduces a remote voter registration scheme, in which biometric systems play an important role to protect the accuracy of the electoral roll (Victor Morales et al. 2008 and Mohammed Khasawneh and Mohammad Malkawi 2008). Biometric systems have been already considered in electronic voting in the voting phase. In this system the first step consists of checking by registration officers where they have to see whether the voter included in the form is the same that is stored in the voter register. Some examples could be the date of birth, the social security number or any other familiar information (e.g., mothers' maiden name, etc.). The problem with using such information for identifying the voter is that this information could be available in other databases (e.g., the member database of a social club) or could be known by people close to the voter. The second step consists of verifying the identity of the voter based on checking some voter personal characteristics, such as a handwritten signature stamped on the form or the face or fingerprint of the voter against an image or template contained in some identity card or database.

Issues in current online remote voting systems

The existing online remote voter registration methods do not check whether the same person has filled more than one registration form by using the names of different valid voters. The contents of the registration form can be altered after the voter has sent this form. The problem identified

in handwritten signature is that, it is not bound to the contents of the register. Therefore, the current voter registration systems face the following problems.

Architecture Diagram

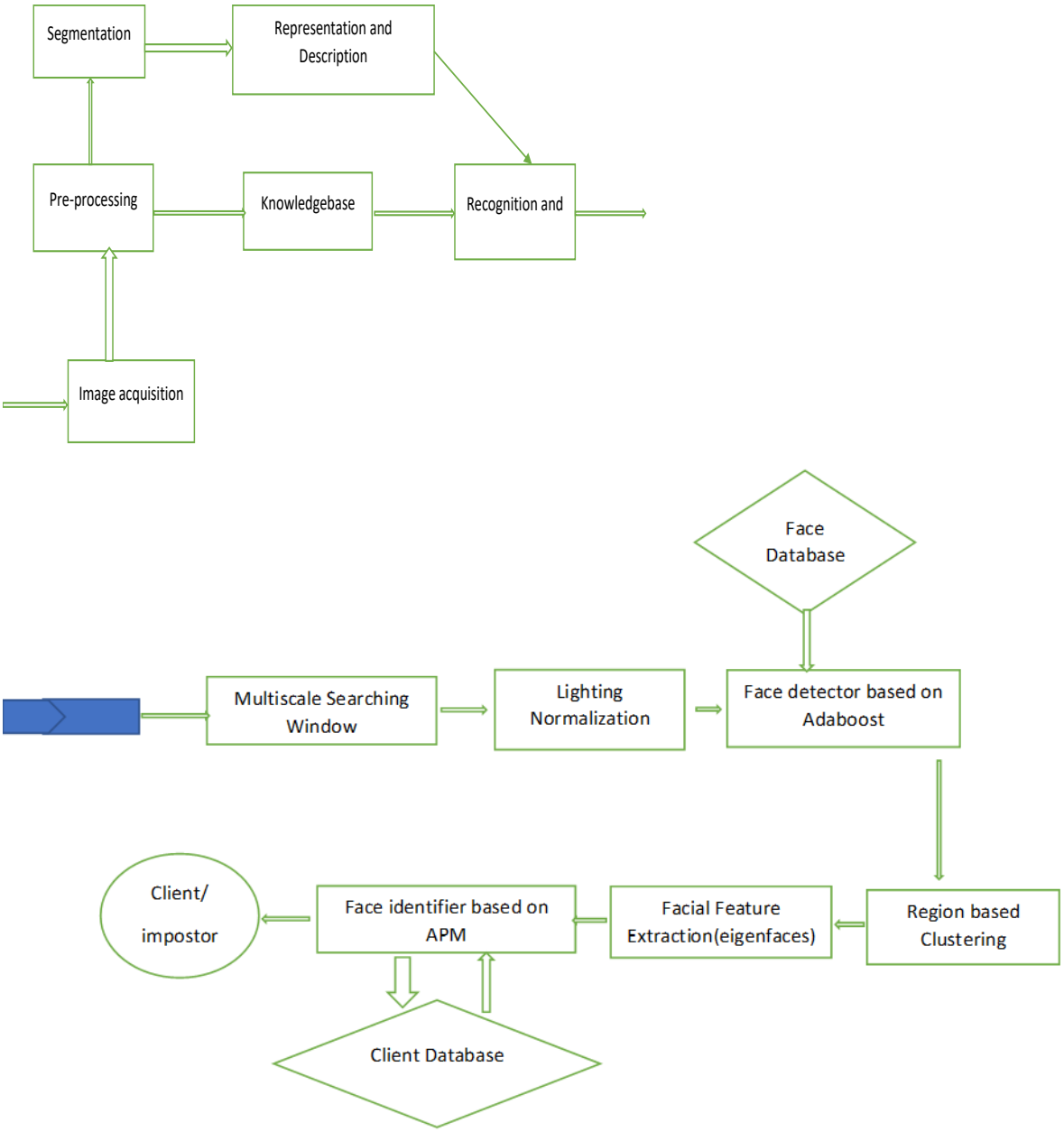


Fig: Architecture Diagram

CHAPTER-V

OUTPUT

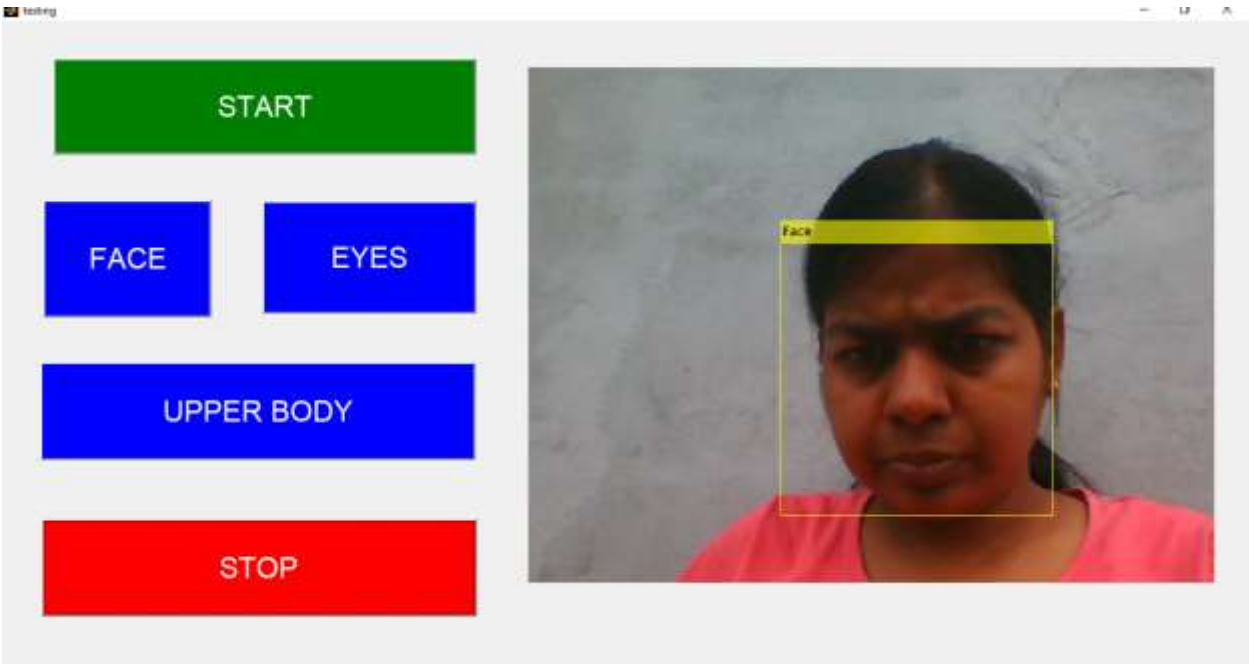


Fig: Face

Fig: Eye

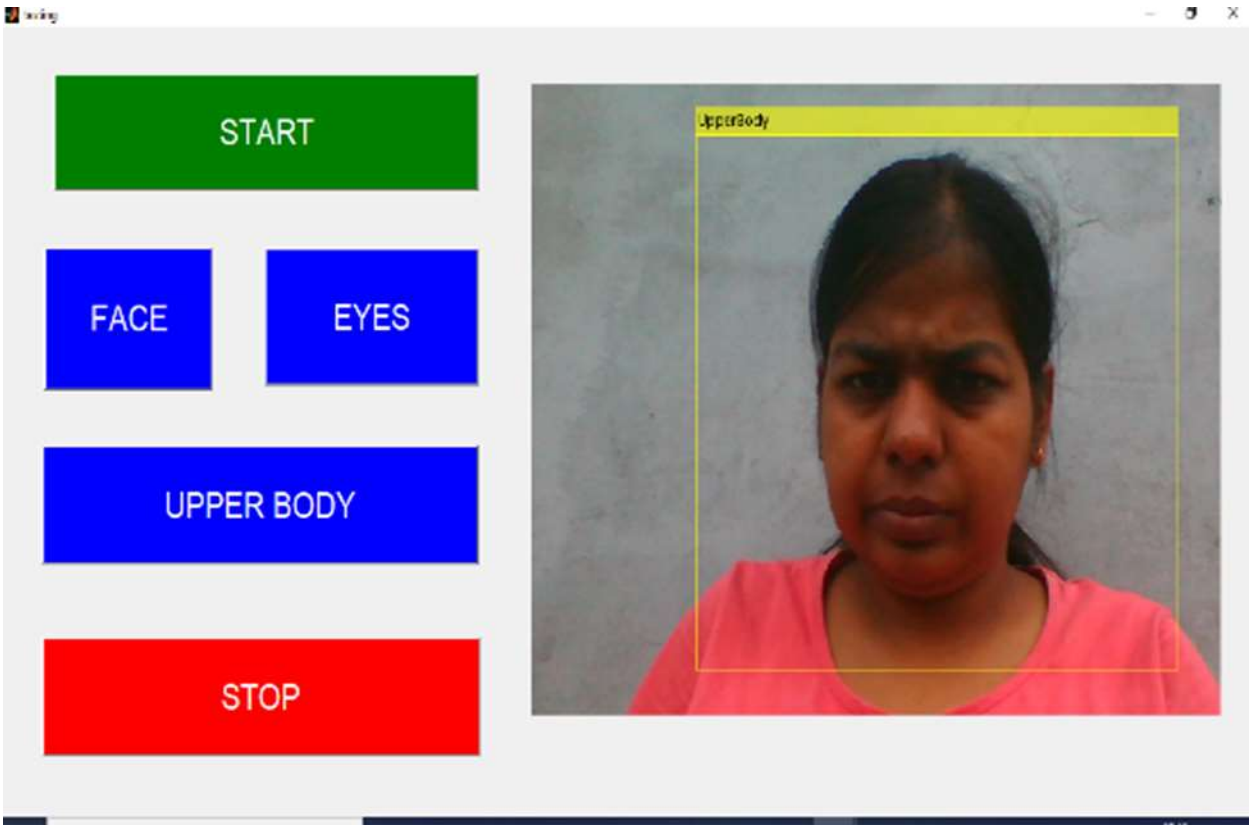


Fig: Upper Body

CHAPTER-VII

CONCLUSION

Our goal is to provide the users a wonderful experience of studying and gathering knowledge. The computational models, which were implemented in this project, were chosen after extensive research, and the successful testing results confirm that the choices made by the researcher were reliable. The system with manual face detection and automatic face recognition did not have recognition accuracy over 90%, due to the limited number of eigen faces that were used for the PCA transform. This system was tested under very robust conditions in this experimental study and it is envisaged that real-world performance will be far more accurate. The fully automated frontal view face detection system displayed virtually perfect accuracy and in the researcher's opinion further work need not be conducted in this area. The fully automated face detection and recognition system was not robust enough to achieve a high recognition accuracy. The only reason for this was the face recognition subsystem did not display even a slight degree of invariance to scale, rotation or shift errors of the segmented face image. This was one of the

system requirements identified in section However, if some sort of further processing, such as an eye detection technique, was implemented to further normalize the segmented face image, performance will increase to levels comparable to the manual face detection and recognition system. There are better techniques such as iris or retina recognition and face recognition using the thermal spectrum for user access and user verification applications since this need a very high degree of accuracy. The real-time automated pose invariant face detection and recognition system would be ideal for crowd surveillance applications. The implemented fully automated face detection and recognition system (with an eye detection system) could be used for simple surveillance applications such as ATM user security, while the implemented manual face detection and automated recognition system is ideal of mug shot matching., were we obtained in this study, which was conducted under adverse conditions. Implementing an eye detection technique would be a minor extension to the implemented system and would not require a great deal of additional research. All other implemented systems displayed commendable results and reflect well on the deformable template and Principal Component Analysis strategies.

CHAPTER-VIII

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