Implementation of Face Recognition System

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ABSTRACT

Face Recognition is the ability to detect and recognize a person by their facial characteristics. Face is a multidimensional and hence requires a lot of mathematical computations. Face recognition system is very essential and important for providing security, mug shot matching, law enforcement applications, user verification, user access control, etc and is mostly used for recognition for various applications. These all applications require an efficient Face recognition system. There are many methods that are already proposed and have low recognition capability, high false alarm rate. Hence the major task of the research is to develop face recognition system with improved accuracy and improved recognition time of an face recognition system. This paper proposes a hybrid face recognition algorithm by combining two face recognition techniques by integrating (PCA) principle Component Analysis, (LDA) Linear Discriminant Analysis. Jacobi method is used to compute Eigenvector that are necessary for PCA and LDA algorithms. Face Recognition system will be implemented on Embedded system based Raspberry pi 3 board.

INTRODUCTION

Everyone has had the experience of not recognizing someone they know due to changes in pose, facial expressions, illumination and expressions. So it's not surprising that computer vision system may face the same problems. Despite of years of work on computer vision scientists from all over the world are not able to match that of human performance. Still Face Recognition Systems are not poor. The best systems can overrun human performance under fixed ideal condition. But the performance decreases drastically as conditions change. Face recognition system first requires a set of database images. The first task is to create dataset of images on which your algorithm can be tested. Thanks to a readymade dataset of images called " AT& T" dataset images which have been captured with different poses, variations, expressions. In this project these dataset images will be used to test the proposed algorithm which consists of 400 images of 40 persons each having 10 different images which have pose and expressions variations. The task of Face Recognition Algorithm is to compare two images and determine if they belong to the same person. Face

Recognition system are developed to detect and recognize a person that differ in characteristics. The Face Recognition Systems have evolved greatly during the last some decades. Because of this development there is increase in algorithmic complexity which takes long computation time and power. Many algorithms such as Principle Component Analysis, Linear Discriminant Analysis, Independent Component Analysis, Fuzzy Logic, Support Vector machine, Genetic algorithm have been used for face recognition systems. In this paper a combination of PCA [8] and LDA [7] algorithm have been proposed to implement Face Recognition System on Raspberry pi 3 [11],[12],[13]. The Face is multidimensional and therefore has "Curse Of Dimensionality" that is face requires a lot of memory and time for processing. To overcome this issue optimal features has to be obtained to improve accuracy and remove noise from images. PCA is extensively used to reduce dimensionality. Next after reducing the dimensionality the images are projected onto eigen space using LDA. To do this we need Eigen value calculation. Jacobi Method to calculate Eigen values and Eigenvectors have been used that give approximated Eigenvectors and Eigenvectors. PCA and LDA algorithms project all the training AT&T dataset images onto eigen space. The unknown image, that is test image is also projected onto eigen space. For the recognition purpose the Euclidean Distance is calculated between the test image and all the training images. The trained image that has minimum Euclidean distance to test image ie Unknown image is the correct match. Face recognition systems have wide applications. An efficient face recognition can be of great help in identification of persons, Forensics science, authentication systems, mug shot matching,user access and security systems

OBJECTIVE OF THIS PROJECT

The face recognition procedure simply requires any device that has digital photographic technology to generate and obtain the images and data necessary to create and record the biometric facial pattern of the person that needs to be identified.

Unlike other identification solutions such as passwords, verification by email, selfies or images, or fingerprint identification, Biometric facial recognition uses unique mathematical and dynamic patterns that make this system one of the safest and most effective ones.

The objective of face recognition is, from the incoming image, to find a series of data of the same face in a set of training images in a database. The great difficulty is ensuring that this process is carried out in real-time, something that is not available to all biometric facial recognition software providers.

The facial recognition process can perform two variants depending on when it is performed:

- The one in which, for the first time, a facial recognition system addresses a face to register it and associate it with an identity, in such a way that it is recorded in the system. This process is also known as digital onboarding with facial recognition.

- The variant in which the user is authenticated, prior to being registered. In this process, the incoming data from the camera is crossed with the existing data in the database. If the face matches an already registered identity, the user is granted access to the system with his credentials.

REVIEW OF LITERATURE

There are many different recognition methods and we here summarize some of them. Authors in [6] proposed a face recognition system on mobile phones based on the input image, by using Viola-Jones algorithm, applying a set of preprocessing for ROI, and then using principal component analysis (PCA). The goal of the system is to save time and give an easier access for searching pictures. Authors in [15] presented a new application for face recognition on mobile devices based on Bridge Approach (BA) to enhance the speed up the processing and it allows using the system in any location where an internet is available. Face detection and feature extraction are implemented using OpenCV library, but the face recognition is performed in WEKA library. Authors in [16] offered a design and implementation of a face recognition system for the mobile phone platform by including face and eye detection and applying a set of preprocessing for ROI. The recognition used methods are the Principal Component Analysis (PCA) that achieves an accuracy of 93.8% and the Linear Discriminant Analysis (LDA) that achieves an accuracy of 96%. Authors in [5] made deployment face recognition on mobile devices. They used the PCA algorithm for recognition. After applying the system, the accuracy was approximately 92% for a chosen

threshold and the time taken to recognize the person is 0.35 sec for a small number of testing images. Authors in [14] implemented a face recognition system in MATLAB and then simulated it on DROID phones. It investigated multi algorithms for face detection (color segmentation, template matching) and proposed two methods for recognition (Eign & Fisher face). It achieved a recognition rate of Eign face about 84.3%, fisher face 94% and the computation time on DROID was 1.58 sec.

1) Face Detection System:
In this section we will describe a about Face detection which has several modules that are working together as one to make the system to run properly. The phase consists of capturing image and Detecting face in image. Image can be captured in real time from USB webcam connected to Raspberry pi. The function of face detection module is to clarify whether a face is available during real time application. The face detection is done by scanning an image and finding some pattern that represents face. When the system detects the face, it will produce a sub-image such that face appears in the centre and has uniform size. Open CV already have algorithms to locate faces in images and videos. Haar Classifier which is a modification of AdaBoost [15] algorithm scans the input image from webcam and creates a box for each face present in image. Haar classifier used for face detection tries to find characteristics of face components such as eyes, nose, mouth, etc in an image. It analyses these

features and generates a template for each face. The template consists of reduced set of data which represents face bounded in a box.

2) Face Recognition System:

This section deals with PCA and LDA for face recognition. First we need a set of Database of images using which the algorithm will be tested. AT&T dataset images will be used. The first step is to read all the dataset images that will be used for training purpose.

BLOCK DIAGRAM
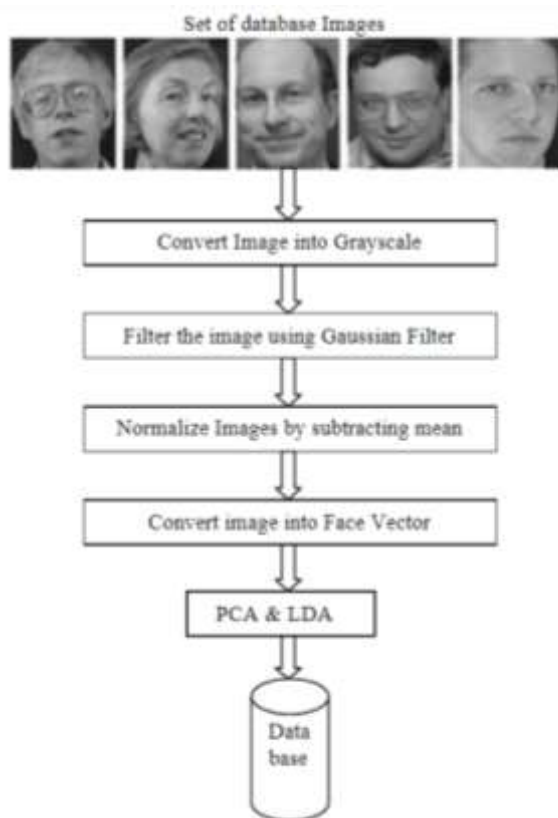
WORKING PRINCIPLE

Before Implementing the design on Embedded platform the design was initially modeled in MATLAB which is the easiest and simplest environment for Scientists. Matlab is used in both academics and industries as software

development tool. It is an interactive numerical computation and data visualization tool which along with wide programming capabilities which makes it useful for almost all areas of science and engineering. Matlab is one of the leading software packages for numerical computation and it mainly deals with Matrices right from scalar to multidimensional matrices. Ones tested and debugged, the entire code was rewritten in python language. Several python libraries were used along with python to perform certain task. Open CV library was used to detect a face in captured image. This helps us for subsequent recognition task using PCA and LDA algorithm and less pre processing is required. The USB web cam sends a video stream of image frames that are received by the Raspberry Pi through USB interface. Once received, the python GUI implements the Face detection using open CV and face recognition using PCA and LDA algorithms. The SD card holds the necessary software to implement these algorithms and it also holds database of Images. Once the test image is tested recognized face along with test face is displayed on the screen.
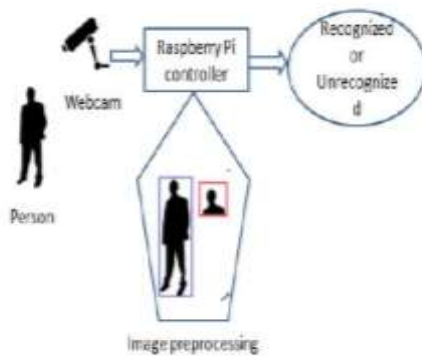
Fig 7. Figure showing hardware implementation of Face Recognition System.

RESULT AND DISCUSSION

The performance of proposed algorithm is evaluated on AT&T dataset of images. AT&T dataset of images consists of 400 face images of 40 individuals with 10 images per person each having dimensions of 112*92 pixels. Each pixel consists of an 8-bit gray scale value ranging from 0 to 255. The images are taken at various different times varying in light, facial expressions, pose, etc. The images are in PNG format Fig. 8. Figure showing Recognition Results of face recognition system As can be seen from Figure 8 Query 1 image of a person is used for testing purpose whose similar variant image is present in our database as a result there is a match from our database and person is recognized whose Euclidian distance is minimum. Query 3 image of a person is present in our database and same image is used for testing purpose as a result there is a match from database and Euclidian distance calculated is zero. Query 5 image of a person is not present in our database. Hence the result shows that image not found as the threshold

value Q is very large. The threshold value that is found in this project is 3500. Using AT&T dataset of images the accuracy of PCA and LDA algorithm is measured for our Face recognition system. The algorithm was applied to AT&T dataset of 100 training images of 20 persons taking 5 images of each person for training purpose. The accuracy of FACE RECOGNITION Proceedings of the IEEE 2017 International Conference on Computing Methodologies and Communication (ICCMC)978-1-5090-4890-8/17/$31.00 ©2017 IEEE 254 using PCA alone was found to be 91%, the accuracy of LDA alone was found to be 94% and that of proposed method was found to be 97% when implemented on raspberry pi 3 board.

TABLE I. TABLE SHOWING ACCURACY OF ALGORITHMS

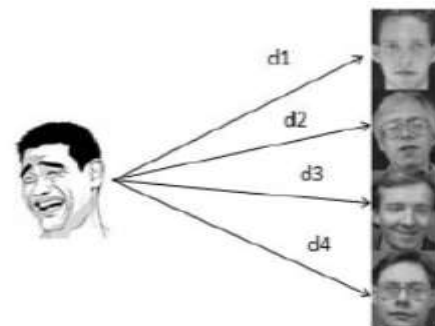| Images	Algorithm	Accuracy(%)
100	PCA	91
100	LDA	94
100	PCA+LDA	97

Fig. 6. Figure showing Recognition of image not in database.

CONCLUSION

In this paper, I have proposed an efficient Face recognition system based on PCA and LDA. Using these two combination of methods have given me accuracy of 97% by using raspberry pi 3 module. The Raspberry pi 3 module is a cost effective module and is a low weight compact module to be used for recognition system. This project on Face Recognition has given me an opportunity to study many face recognition algorithms that were used and being currently used. This project has also provided me with the knowledge that combining two or more methods increase the accuracy of Face recognition system. In future this Face recognition system could be incorporated on a Robot to make it more Human like.

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