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Automated Real-Time Face Recognition and Tagging

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ABSTRACT

This paper mainly addresses the building of facial recognition software which falls into a large group of technologies known as biometrics. It has been one of the most interesting and important research fields. The methods may vary, but they generally involve a series of steps that serve to capture, analyze and compare your face to a database of stored images. For automatically identifying or verifying a person from a digital image or a video source, there is a need for an automated face recognition system. One of the ways to do this is by comparing selected features of the faces from the image and the database of several faces. Automatic face detection is a complex problem in real-time video processing. This problem is commonly referred to as face location, face extraction, or face segmentation. This paper presents a new algorithm to automatically segment out and recognize a person's face from a real-time video and the main objective is to tag the faces accordingly by comparing the facial features from the existing dynamic database. By using this technique a large number of individuals or a group of people can get benefited. This is the reason which is responsible for a great need in the field of facial recognition.

Keywords: Face detection, Face recognition, Feature Extraction, Eigen face, Eigenvector, Haar-like features, PCA, LDA, ICA, MCPA, LPP, Feature selection, Dimension reduction, Covariance.

I. INTRODUCTION

The face plays an important role in our social life conveying our identity and emotions. It is the primary focus of attention in a human being. One can recognize and identify the maximum number of faces at a glance which they have seen or observed in a lifetime even after years of separation. This skill of human being is quite robust despite of large variations such as aging, changing conditions and distractions such as glasses, beard or changes in hairstyle.

In face recognition, Computational models are interesting because they can contribute to practical applications also along with the theoretical knowledge. Computers that detect, identify and recognize faces can be applied to a wide variety of processes including security system, criminal identification, image and film processing, verification of identities, tagging purposes and human-computer interaction. Unfortunately, as faces are multidimensional and complex having meaningful visual stimuli, developing a computational model of face detection and recognition has become quite difficult.

The automatically tagging feature acts like a new dimension to share pictures among the people in the picture. It also helps other people to identify the person in the image. In this paper, we have studied and implemented a simple but very effective face detection algorithm.

Our aim is to develop a method for face recognition and tagging which is fast, reasonably simple, robust and accurate with easy to understand and relatively simple algorithms and techniques. The examples provided in this paper are real-time and taken from our own surroundings.

II. FACE DETECTION

Face detection is done by Feature-based approach which makes use of the different unique elements of a human face such as eyes, nose, and lips to detect a face. This approach is reliable because the structure and size of these elements of a human face are different from the non- face objects. Also, the positions of the elements in the human face are related to each other and are always on the face of the subject. As human skin has unique colour and texture than that of non-face objects, it is also used to detect the face nowadays. Here highlighting the desired region of a face is an important task which can be done with the help of edges of an object by using blobs and contours for this purpose.

Feature-based approach first step is to locate the face on the image. In this method, the skin region is found. It is also validated by finding at least one eye in the image. The second step is to identify the facial features which are also known as fiducial points. In this process, eye detection is done by using the concepts of Haar-like features and cascade classifier. Haar-like features are nothing but simple rectangular features which locates the rectangular regions containing the eyes of a human face.Here hue information of the eye image is taken to develop an algorithm which can locate the eye pupil in the given rectangular region of the eyes. So using this hue image which is a threshold, a contour is detected in the threshold image where the centroid of the contour is measured to find the eye pupil.

Next step in this approach is to detect the nose of a human face in the image. This process is done by using Haar-like features which locates the rectangular regions containing the nose of a human face. As the center of the eyes and the position of the nose are located based on the geometry of the face and its features, an approach is proposed to detect the location of the mouth. This approach states that the uniform distance between the eye and the nose tip in a detected face location are enough to find the other element of the face.

Figure1. Face detection result

Figure2. Nose detection result

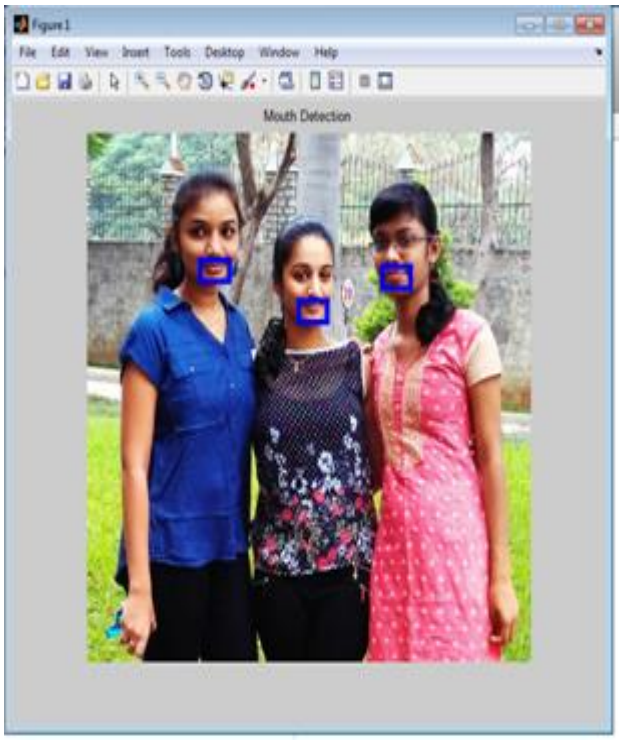

Figure3. Mouth detection result

III. FACE RECOGNITION

Face recognition is done by using Principal Component Analysis technique often called as PCA. PCA is one of the popular methods for selection of the features and reduction of its dimensions. The Face recognition in an image is achieved by using the reduced data space which is extracted from the process of eigen face method. Basically, eigen face method defines a feature space that reduces the dimensionality of the original data space. Some of the common problems that arise in this PCA method are large computation and poor discriminating power within the class. These problems are overcome by Linear Discriminant Analysis (LDA).

LDA is the most popular and powerful algorithm used for selection of features in appearance based methods. Here the face recognition system first uses PCA method to select features, reduce its dimensions and then uses LDA method to maximize the discriminating power, reduce the complexity of computation in feature selection process. This LDA method shows good results in discriminating features extraction if the selected dataset have larger samples per class in the database. But when LDA is implemented directly with smaller samples per class in the selected dataset, it will result in poor extraction of discriminating features.

In this proposed method of face recognition, a filter called Gabor filter is used to filter frontal face images, PCA method is used to select the features and reduce the dimension of filtered feature vectors and then LDA method is used for feature extraction purpose. When PCA, LDA and ICA methods are tested and compared for the face recognition of colored images, PCA is found to be better than LDA and ICA methods under different illumination variations. As PCA method is less sensitive to partial occlusions than LDA and ICA methods, PCA method is used as a feature selection and dimension reduction technique for modeling expression deformations in a face recognition system.

A simple yet recursive algorithm is introduced for calculating the Discriminant features of PCA-LDA procedure. This algorithm process focuses on the challenging issues of computing vectors of discriminating nature which are from an incrementally arriving high dimensional data stream without computing the corresponding covariance matrix and also without knowing the data in advance.

The proposed algorithm of incremental PCA-LDA method is very efficient in the usage of memory and also in the calculation of first basis vectors. This algorithm produces an acceptable success rate of face recognition when compared with other face recognition algorithms such as PCA and LDA methods. Here high face recognition rate is achieved by combining two techniques called Modified PCA (MPCA) and Locality Preserving Projections (LPP**).**

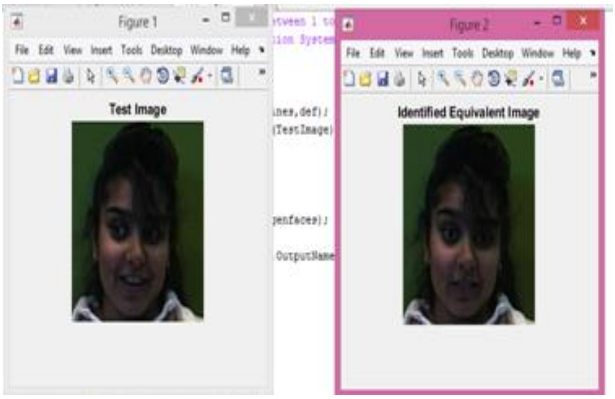

Figure 4. Face Recognition result

IV. TAGGING THE FACES

After the detection and recognition of each face, the final process is to recognize the identities of the faces. In this process, the building of face database is essential in order to achieve automatic recognition. For each person, several images can be taken in different angles and their features can be extracted and stored in the database with the details of name etc. Then finally when the image of a face comes in as an input to the system, it performs face detection, feature extraction and compares its features to each face class stored in the database. The system then gives the details of the matched face from the stored database as the output result.

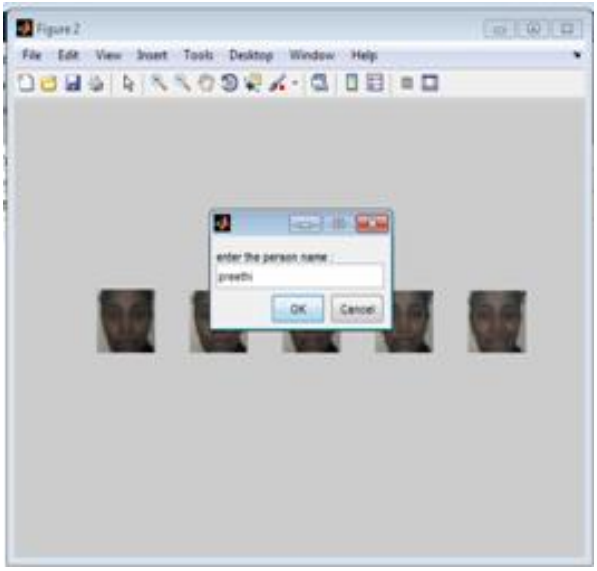

Figure 5. Several images of a person is taken as input

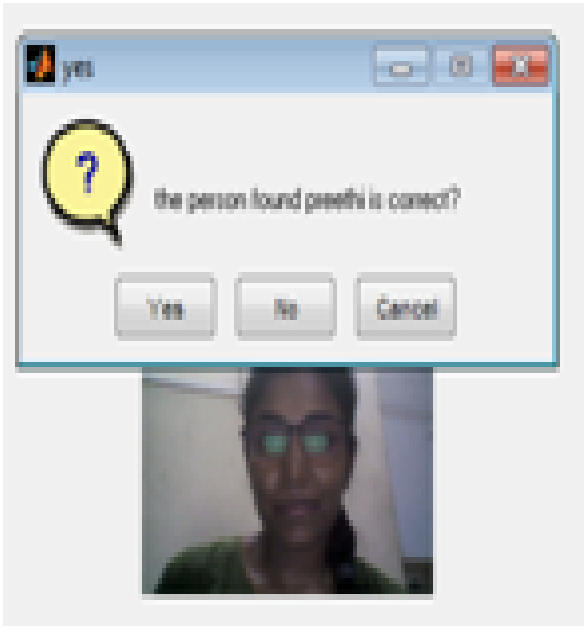

Figure 6. Result of tagging the face.

V. CONCLUSION

In this paper, the goal concept of implementing an automated real-time software system to detect, recognize and tag human faces is achieved. Implementation of the algorithm was examined in MATLAB to check the accuracy of the software. Although there are some modifications are required to the original algorithm for the transition of concept from software to hardware, the initial goal was still accomplished.

The face detection algorithm was derived from Viola-Jones face detection method. Face tracking was achieved by computing the centroid of each detected region, although it only worked in the presence of at most two people. Different types of the filter were applied to avoid flickering. The system was proved to work in real-time with no lagging and under varying conditions of facial expressions, skin tones, and lighting.

VI. FUTURE WORK

To implement the face detection and recognition in live video streaming technology and tagging the faces in live videos which can be used for the following:

- Automatic log of student's attendance
- Maintaining the log of restricted persons
- Log of Rule violating persons in public area.

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