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Criminal Identification through Face Recognition

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***Abstract*—** The face is one of the distinguishable marks of humans. Face Recognition can be used as a personal identification system that uses the unique characteristics of a person to identify a person's identity. Some of the existing applications of face recognition systems are Biometric Information Process, Human-Computer Interaction, Deployment and Security Services, Criminal Identification, Health Care, Access and Security and so on. In general finger prints were used for identifying criminals. In this paper, we focus our task to Criminal Identification through face recognition technology. Here we maintain the images of criminals in a database. When an image is given as an input to the system, using a face recognition algorithm, the system needs to identify whether the inputted image exists in the criminal list or not. If exists then displays the name of the identified criminal otherwise displays as unknown.

***Keywords*—**Face Recognition, Biometric Information, Criminal Identification

I. INTRODUCTION

In recent years, face recognition has become one of the emerging technologies. It has various applications in communication, computer vision and automatic control system. Face detection [1] is a method to detect a face from an image, which has several attributes in that image whereas face recognition [1] is a software application capable of uniquely identifying or verifying a person by comparing and analyzing patterns based on person's facial patterns. Hence face recognition is an easy task for them. However, it is a complex task for computers as it sees the image as an array of pixels.

Face detection becomes tricky when the faces in the image are dark, not clear, occluded by other things and not facing the camera. From the past two decades, many face recognition algorithms have been developed like Linear Discriminant Analysis (LDA) [2], Histograms of Oriented Gradients (HOG) [3], Principal Component Analysis (PCA) [4], wavelet transformation [5] and locality preserving projection [6]. Still most of the successful techniques also fail to address One Person One Sample (OPOS) [7] problem, which mean only one training sample is present per person in the database. In paper [8] they proposed a solution to this problem through wavelet transformation technique. Steps to enlarge the training dataset using wavelet transformation technique as mentioned in paper [8] are as follows:

1. Firstly, a facial image is selected and then it is rotated with a range of small angles. Then we get a number of samples of same image with different views known as virtual samples as shown in Figure1.
2. Secondly, wavelet transformation is performed on all samples.
3. Finally, low frequency part is selected from each sample because low frequency part contains more information.

Figure 1. Virtual samples generated from original image

Using this wavelet transformation technique we have proposed a system for criminal identification through face recognition. As crime rate is increasing, maintaining all the data in books and searching for the details of criminals becomes a hectic task. Therefore, the criminal details are to be maintained digitally. Hence, we thought of "criminal identification through face recognition" system. In this, a database with images of criminals is used. The training set of each criminal is enlarged by applying the above-mentioned wavelet transformation steps. When an image is passed as an input to the system using the face recognition algorithm, it checks whether the person in the given image is already present in the criminal list or not. If the person is not present

in the criminals list but identified as a criminal then the image of that person is added to the database. This can be used to identify the criminals in the public meetings.

II. RELATED WORK

Some of the existing methods that are used for face recognition are:

A. Histogram of Oriented Gradients (HOG)

HOG is one of the descriptors among many others. HOG is invariant to geometric and photometric transformations as it operates on local cells. It is a dense feature extraction method for images in the form of gradients. Using these gradients, it tries to capture the shape of the structure in images and then performs normalization. However, it is widely used for pedestrian detection and rarely for face recognition. It also fails under varying light conditions. The various other factors that affect the performance of the HOG are variation of scales, cell size, orientation bins, overlapping, angle representation, etc.

B. Principal Component Analysis (PCA)

PCA is one of the most popular techniques used for face recognition. Here the image is presented as a small dimensional vector (main component), which is then compared with benchmark vectors from the database. The main purpose of PCA is significantly reducing the dimensionality of the features that allows them to describe the typical features of different faces. First, an inputted training set of faces is transformed into one common data matrix. Using this matrix, the inputted images decomposed into a set of linear coefficients called principal components or eigenfaces [9] for fast results. But it suffers from the OPOS problem.

C. Wavelet Transformation

Wavelet Transformation technique addresses the OPOS problem. One of the key problems in the face recognition with single training image per person is insufficient training samples. The natural way is to enlarge the training set. Thus, wavelet transformation is applied on an image and then virtual samples are generated for enhancing the detection accuracy. Then using PCA face recognition is performed with high accuracy.

D. Local Binary Patterns Histograms (LBPH)

LBPH is not only the oldest but also one of the most popular face recognition techniques. At first, it is described as Local Binary Patterns (LBP) [10], used for texture classification. Later LBP is combined with HOG descriptor to enhance the performance rate of face recognition. Here the face images are represented in the form of data vectors. In LBPH, the first step is to create an intermediate image that describes the original image in a better way, by highlighting the facial characteristics. Now this intermediate image is used to extract the histograms of each region and then concatenated to get the final histogram of the original image and it is used during the recognition for better results.

III. METHODOLOGY

There are a number of databases available over the internet like ORL database, Yale Face database, Pie database, etc. In paper [8] they have worked on the ORL database. They have conducted their experiments in Matlab. In addition, a number of wavelet bases are available like Haar, Daubechies, Symlets, Coiflets, Biorthogonal, Shannon, etc. They have selected the Daubechies, Symlets and Biorthogonal wavelet bases and have compared them in terms of the recognition accuracy and computation time. They also compared their proposed method (wavelet transformation) with PCA, and found that the recognition accuracy for their proposed method is higher than the remaining methods. Hence, we thought of working on the same method by selecting the other wavelet basis, named “haar” [11].

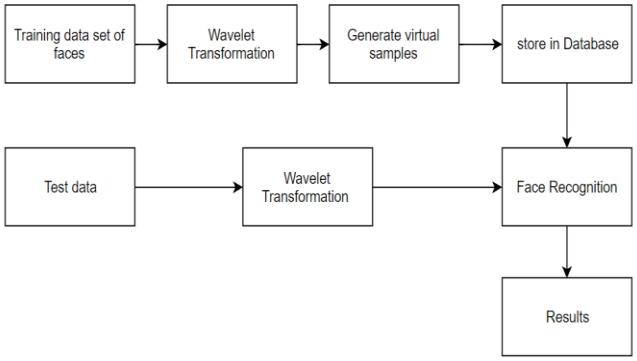

Figure 2. Block Diagram

The proposed system is implemented in Open CV using the built in libraries of the python. For detecting the faces, we are using the haar wavelet classifier and for recognition, we are using the Local Binary Patterns Histogram LBPH [12]. For wavelet transformation there is a built in package named “pywt” available in Open CV. Systematical process of our proposed system is shown in Figure 2.

IV. RESULTS AND DISCUSSION

Initially wavelet transformation is applied on the training set, virtual samples are generated, and then they are stored in the database. Wavelet transformation is also applied on the test data before performing recognition. In Figure 3, face detection is shown.

Figure 3. Detecting the face of a person

As shown in Figure 4 the system recognizes the face and displays the name of the identified face. If the system fails to recognize the face then it displays "unknown" as shown in Figure 5.

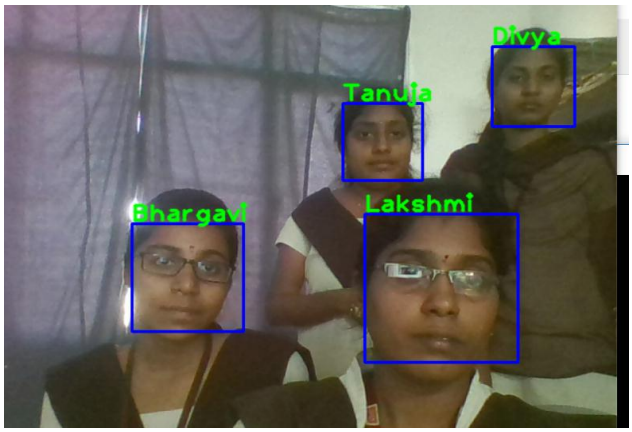

Figure 4. Recognition of faces using LBPH

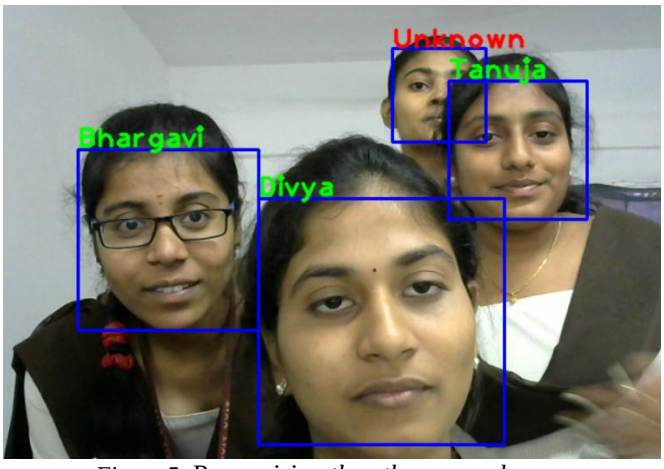

Figure 5. Recognizing the others as unknown

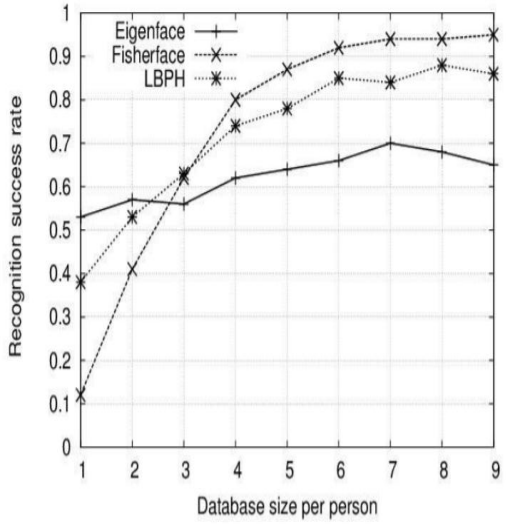

Figure 6. Comparision graph for LBPH, Eigenfaces and Fisher faces.

A graph is plotted between database size per person varying from one to nine and recognition success rate among the eigenfaces, fisherfaces and LBPH. Initially PCA has more recognition rate but as size of the database is increasing recognition rate for LBPH is high. Thus, LBPH algorithm used during recognition gives better results compared to the eigenfaces and fisherfaces as shown in Figure 6.

V. CONCLUSION AND FUTURE SCOPE

Criminal identification through face recognition using LBPH algorithm is giving good results. But it doesn't address the concept of aging, it means if there is a large variation in the age of a person's present photo and the one stored in the database. Thus the future scope of our work is to identify criminals using the combination of LBPH and neural networks in the live videos with high accuracy by addressing aging problem also.

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