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Face Detection and Recognition Using Eigenvector Approach from Live Streaming

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Abstract: Face recognition can be considered one of the most successful biometric identification methods among several types of biometric identification including fingerprints, DNA, palm print, hand geometry, iris recognition, retina and odor/scent. Face recognition provides biometric authentication that utilizes the individuality of faces for security purposes. The problem with face recognition using biometric identification is performing it in live streaming. This paper proposes solutions for a faster face recognition process in the live streaming. The proposed face recognition process was done using a hybrid process of Haar Cascades and Eigen face methods, which can detect multiple faces in a single detection process. This improved face recognition approach was ready to recognize multiple faces with 91.67% accuracy level.

Keywords: Face recognition; biometric identification; fast face recognition process; Haar Cascades method; Eigen face method.

I. INTRODUCTION

Face recognition has been used as an authentication process in various fields and especially in computer security related activities, such as homeland security, building access security, criminal identification, as well as user identification in small mobile devices. Face recognition also plays a significant role in the research field of biometric and computer vision. The goal of a face recognition system is to have a negligible misclassification rate. Biometric technology is used for authentication and it may analyze human behavior. Each biometric system has its own advantages and drawbacks, in order that proper consideration is required when selecting one to use in an application. Face detection algorithms are considered to need intensive computation, which makes it's difficult to perform face detection. Most of the face recognition processes are implemented on a single face at a time. For a single face to be recognized, it may need a short period of time, but for many faces/people, using single face recognition, it will take a lot of time. Thus, it is necessary to develop a system for multiple faces recognition in one go to speed up the recognizing process. This paper presents a study on multiple faces recognition using a hybrid method of Haar Cascades and Eigenface.This study aims to improve the performance of face recognition process using the Haar Cascades and Eigen face method. OpenCV can be used as a face detector type that works with the Haar-cascade classifier. From an image, a face detector will test each part of the image and classify it as "face" or "not face". This facial classification uses a fixed scale, for example 50 × 50 pixels. If the face of the image is larger or smaller than the fixed scale, the classifier continuously processes the image, searching for a face. The classifier can use data stored in an XML file to decide how to classify each image location. The next part of this paper presents previous works that are related to face recognition, especially ones that can identify multiple faces. It is then followed by the methodology used in the study presented in this paper. Later, the results of the experiments conducted are presented and discussed in section IV. Then, the conclusion of this study can be found in section V.

II. RELATED WORK

Face recognition is one of the fastest growing research areas and it has been used in many domains. In the field of education, it is shown to have the ability to detect, analyze and process emotions in order to get positive teaching effects such as perception, understanding and expressing emotions. This approach consists of three stages: Feature extraction, subset feature and emotion classifier. A Haar Cascades method is employed to detect the input image, a face,

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because the basis for the feature extraction of the eyes and mouth, then the Sobel edge detection is used to obtain the characteristic value. There are two major approaches for feature extraction, typically holistic feature and native feature. In the holistic feature-based approach, the features are extracted from the face as a whole, which may sometimes be affected by occlusion and expression changes. Whereas in local features-based approaches, these are overcome as patches of the image are considered. Also, they are scale and rotation invariant. This study used the holistic feature approach using Eigen face. Facial recognition systems have been used in small mobile environments as well, to recognize images and video. It uses multiple object detection using the Viola-Jones cascade classifier in the OpenCV library. A frontal face is good for face recognition accuracy. Non-frontal facial images can be reconstructed to frontal face images to increase the accuracy of the facial recognition. Another way to increase the accuracy of the face recognition can be through filtering techniques. As well the similarity measurement can be used in face recognition by utilizing the probabilistic.

III. ALGORITHM USED

An Eigen face is the name given to a set of eigenvectors when used in the computer vision problem of human face recognition. The approach of using Eigen faces for recognition was developed by Sirovich and Kirby (1987) and employed by Matthew Turk and Alex Pentland in face classification. The eigenvectors are derived from the covariance matrix of the probability distribution over the high-dimensional vector space of face images. The eigenfaces themselves form a basis set of all images wont to construct the covariance matrix. This produces dimension reduction by allowing the smaller set of basis images to represent the first training images. Classification are often achieved by comparing how faces are represented by the idea set.

IV. EIGENVECTORS AND EIGENVALUES

"Eigen" may be a German word sense "proper" or "own". An eigenvector of a matrix may be a vector such, if multiplied with the matrix, the result's always an integer multiple of that vector. This integer value is that the corresponding eigenvalue of the eigenvector. This relationship can be described by the equation $M \times u = c \times u$, where u is an eigenvector of the matrix M and c is the corresponding eigenvalue. 2.1 Eigenfaces Eigenfaces are the set of eigenvectors which utilized in computer vision problem for face recognition. They can be simply defined because the eigenvectors which represent one among the dimension of face image space. All eigenvectors have an eigenvalue associated to it and the eigenvectors with the largest eigenvalues provide more information on the face variation than the ones with smaller eigenvalues. 2.2 Principle Component Analysis (PCA) Technique PCA is one among the foremost successful techniques that are utilized in face recognition. The objective of the Principal Component Analysis is to require the entire variation on the training set of faces and to represent this variation with just a few little variables. When we are working with great amounts of images, reduction of space dimension is extremely important. PCA intends to scale back the dimension of a gaggle or to space it better in order that the new base describes the standard model of the group. The maximum number of principal components is that the number of variables within the original space. Even so to scale back the dimension, some principal components should be omitted. 3. FACE DETECTION to locate the face, a picture pyramid is made from the first image. An image pyramid may be a set of copies of the first image at different scale, thus representing a group of various resolutions. A mask is moved pixel wise over each image within the pyramid and at each position, the image section under the mask is passed to a function that assesses the similarity of the image section to a face. If the similarity value is high enough, the presence of a face at that position and determination is assumed. From the position of the face, a primary estimate of the attention position are often derived. A search for the precise eye position is started. The positions yielding the very best similarity values are taken as final estimates of the attention positions. 3.1 Face Image Normalization After the face area has been detected, it is normalized before passing to the face recognition module. We apply a sequence of image pre-processing techniques in order that the image is light and noise invariant. We also need to apply some standard face recognition pre-requisite such as gray image conversion and scaling into a suitable sized image. 3.1.1 Conversion to Gray Image and Scaling Detected face is converted to grayscale using equation (1) and scaled to 60 60 pixel using equation (2) and saved as a gray jpg image. Linear interpolation technique was employed to work out the scaled output

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3.1.1 Conversion to Gray Image and Scaling

Detected face is converted to grayscale using equation (1) and scaled to 60 × 60 pixel using equation (2) and saved as a gray jpg image. Linear interpolation technique was employed to determine the scaled output image.

$$Gr_i = \frac{R_i + G_i + B_i}{3}, i=1,\ldots,M\times N \quad (1)$$

Where Gr_i is the gray level value of i^{th} pixel of the gray image. R_i, G_i, B_i corresponds to red, green, blue value of the i^{th} pixel in the color image.

$$Q(x^q, y^q) = P\left(\frac{x^p}{60}x^q, \frac{y^p}{60}y^q\right) \quad (2)$$

Where, we want to re-scale image $P[(0,0)-(x^p, y^p)]$ to image $Q[(0,0)-(132,132)]$

Type of image	Red	Green	Blue
RGB			
Grayscale			

Figure 1. Conversion of RGB image to Grayscale image

Language used: Python OpenCV

(Open source computer vision) may be a library of programming functions mainly aimed toward real-time computer vision. Originally developed by Intel, it had been later supported by Willow Garage then Itseez (which was later acquired by Intel. The library is cross-platform and free to be used under the open-source BSD license.

PROCESS:

1. Face capturing and training data set is created.

2. The images are processed and converted to yml file

3. In the live streaming the faces are recognized and compared to the yml file the required face is marked as green square

Face capturing and training data set:

- In the live streaming, human face is recognized and the face is captured by using the Eigen vector method
- The particular id of the face will be tagged with the images
- Multiple copies of the face will be stored in the dataset as jpeg format

The process flow

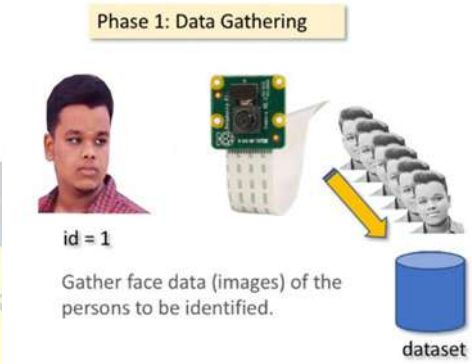

Fig 2-data gathering

Step1:

The id is tagged

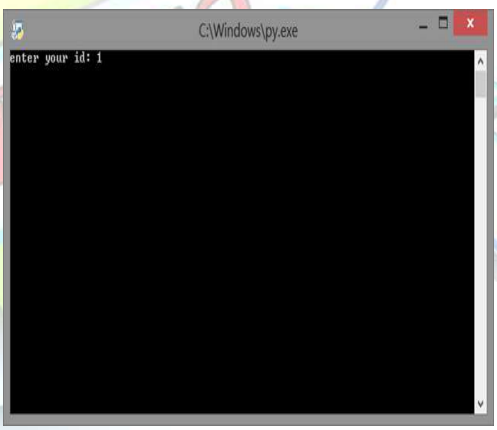

Fig 3-id creation

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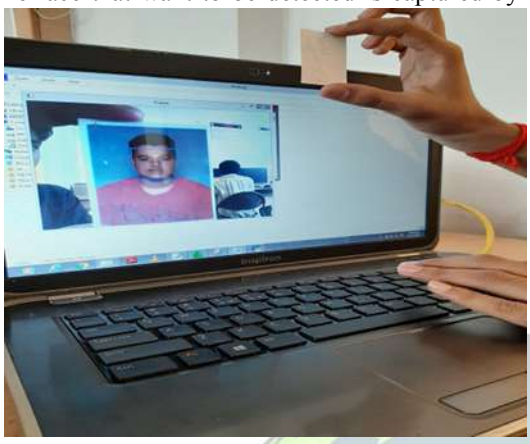
Step2: The face that want to be detected is captured by the



web cam

Fig 4-capturing the image

Step3:

Training data set is created

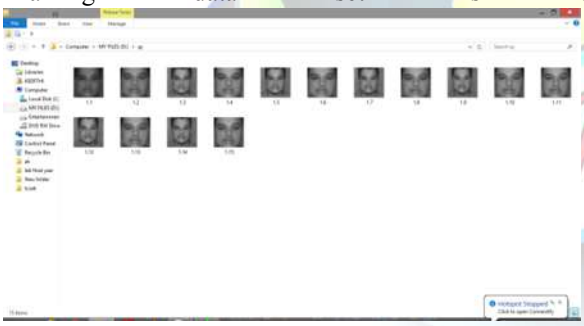


Fig 5- data set creation

The images are processed and converted to yml file:

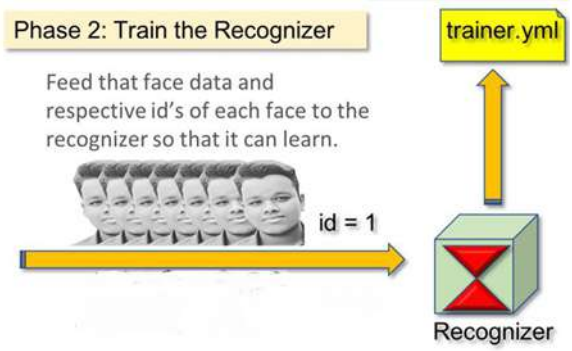


Fig 6-creation of yml file.

In the live streaming the faces are recognized and compared to the yml file the required face is marked as green square:

Fig 7-final output

V. CONCLUSION

Our project is to find the person in a crowd or in any place throughout live streaming. The requirements are webcam, computer and photo of a person to be detected.

LIMITATIONS

Quality of camera should be matched according to the crowd size

In darkness it is hard to recognize

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