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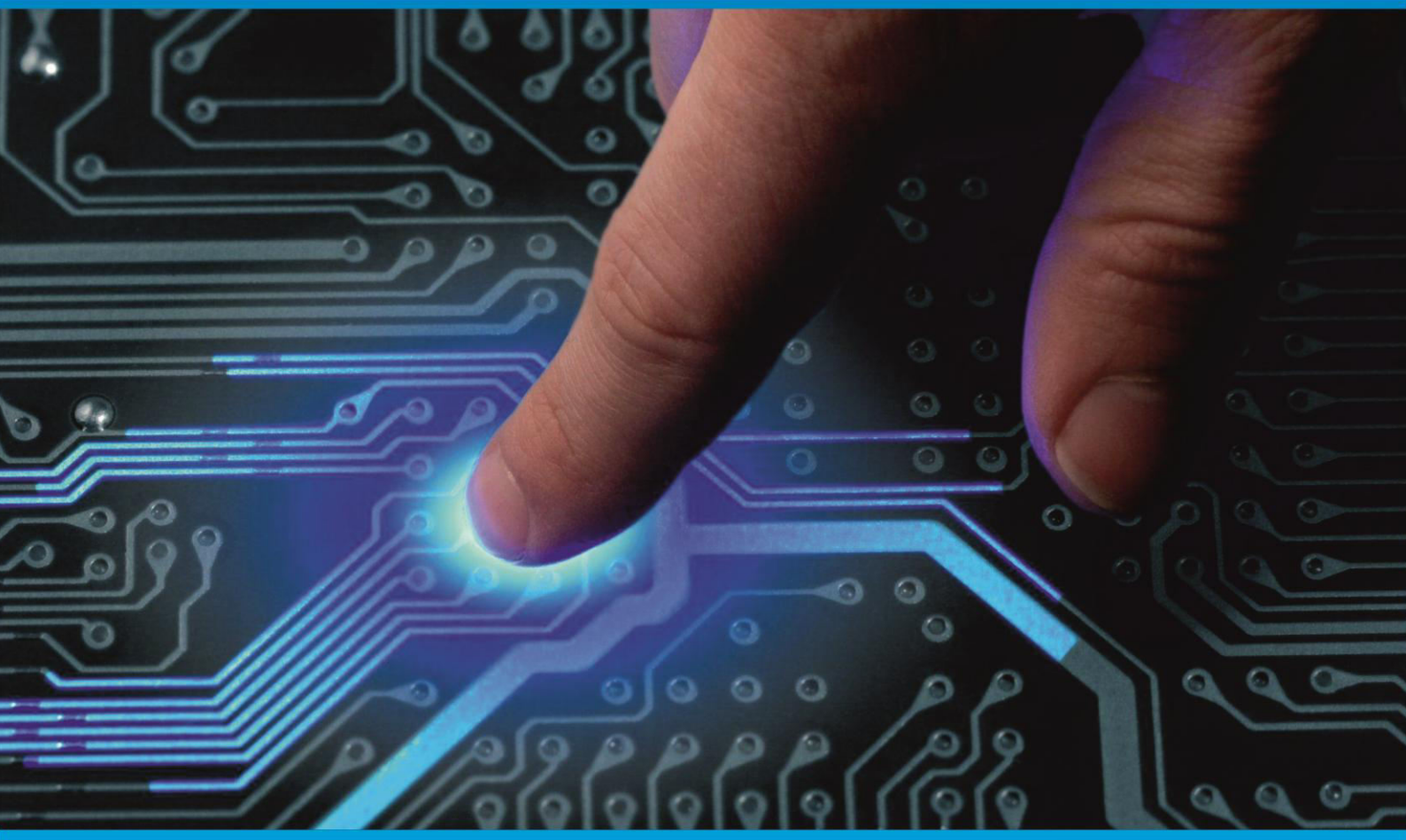

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A Study on Different Face Recognition Algorithm

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ABSTRACT: Face recognition has a wide range of uses at the moment, including security and law enforcement. Face identification is complicated by imaging circumstances, orientation, pose, and the presence of occlusion. Face recognition systems' performance suffers as a result of these issues. To improve recognition results, Discriminant Analysis (LDA) or Principal Components Analysis (PCA) is applied. The human face contains relevant information that may be retrieved using the PCA methodology from a face model. The eigenface approach is used in the Principal Components Analysis method to describe face image variance. There isn't a face recognition technique that works in all situations. Some strategies are better for lighting, some for posing problems, and still others for occlusion.

KEYWORDS: Eigenfaces, recognition, PCA, LDA.

I. INTRODUCTION

Biometric traits can be used to identify a person. Biometrics is a technique for identifying a specific person among a large population of people. Behavioral and physiological biometrics are the two types of biometrics. Face recognition physiological bio metric will be the key focus here. Other physiological biometrics incorporate ear verification, visual vein acknowledgment, and finger prickle detection.The framework's precision is dictated by a blend of datasets and principally two methodologies: human face discovery and highlight extraction.The latter is more difficult because it relies on biometrics to map geometric facial features (such as the distance between the eyes, the length of the nose, the shape of the lip and eyebrow, and the distance between the forehead and chin), and it's one of the most difficult problems in the field .Pose variation, change in captured expression, ageing of the face, variation in orientation, modularity and resolution, blur image, non-presence of face, cluttered image, occlusions such as spectacles or sun glasses, scarf or mask to cover face, and illumination in varying lights are some of the major key challenges in face recognition.

In this paper, we will look at how the face recognition process works, as well as a few regularly used algorithms, as well as the architecture of the face recognition system and its applications. A strategy has been presented for overcoming the occlusion condition. There are also certain tools and technologies discussed.

II. LITERATURE SURVEY

The authors[1] have presented an overview of skin colour segmentation employing three different models, such as RGB, YCbCr, and HSV, helps to remove non-skin colour pixels from the image, which are then evaluated with the face feature extraction approach to ensure it's a human face.This method also calculates skin area, and if any skin area is less than the average value, it will be rejected, which helps to remove small regions internally. The human face has small loops such as eyes, lips, eyebrows, and moustache; if any skin region lacks these loops, it will be easily rejected, reducing the time it takes to track the face. This type of rejection is done by the Euler number.

The authors[2] have presented an overview of the Viola Jones is a face detection framework proposed by Paul Viola and Michael Jones. It has four features, including the Haar feature, which extracts common features from a face using an algorithm and then searches the image for them. AdaBoost training is a classifier used to discard unnecessary features, and Cascading classifiers are used to reject false positive detection in the early stages only. This method achieves a 15-frame-per-second detection rate.

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Robust Face Detection with Hausdorff Distance is a two-stage model-based algorithm that works on greyscale still images. Exposure changes and brightness have no effect on coarse detection and refinement. [3]

Unlike other methods, the Convolution Neural Network Cascade (CNNs) method learns features on its own. This method is useful when we have a large set of data that runs in parallel. On a single core processor, it runs at 14 frames per second. It is made up of six CNNs, the first three of which are used to classify faces and non-faces, and the remaining three for bounding box calibration. [4]

Sirovich and Kirby developed the Eigenface approach. Originally, every face with common features such as the mouth, eyes, and nose was referred to as an eigenface. These features can be extracted using the Principal component Analysis approach, but it is not suited for capturing expression changes.[5]

The author begins by providing an overview of facial recognition in this work. The author has briefly detailed some of the methodologies, such as the holistic technique, feature-based technique, and hybrid technique, as well as listing and discussing some of the applications utilised in the field of face recognition [6]

III. FACE RECOGNITION SYSTEM

The initial stage in a face recognition system is to input an image or video into the system, after which the face is detected and retrieved, and ultimately the face is recognised. All of the steps have been laid out in a flow chart below, along with some of the algorithms that can be applied to each one.

Face Detection

Face detection is the first phase in face recognition, and it is used to detect faces from an image or video in real time. A video is made up of a sequence of frames termed images, which are taken in order to detect the face. Before detecting the frame/image, it is necessary to pre-process it. Face detection can be accomplished in a variety of ways.

Face Detection Algorithms

The primary aim of face detection algorithms is to see whether or not there's any face in a picture.

- **Viola Jones** - is a framework proposed by Paul Viola and Michael Jones for detecting faces. It has four features namely Haar feature, Creating an integral image, AdaBoost training and Cascading classifiers. This method achieves high detection rate of 15 frames per sec. By combining Adaboost with motion detection method which contains face excluding the still background will result better than traditional method. It has lower false detection rate and higher correct detection rate of face is 92.7% with average processing time is 86ms .
- **skin colour segmentation** - It takes three different models like RGB,YCbCr and HSV to remove non skin colour pixels from the image and later those regions are tested with face feature extraction method to get assured it's a human face or not .
- **Hausdorff Distance** - Robust Face Detection using Hausdorff Distance is model based algorithm which works on grey scale still images with two stages Coarse detection and refinement and is insensitive for exposure changes and brightness.
- **Convolution neural network cascade (CNNs)** - This method learns features by itself unlike other methods, this method is good when large set of data which runs parallelly. Its speed is 14 Fps on single core processor.
- **Eigenface method** - It was established by Sirovich and Kirby. Initially were every face having common features like mouth, eyes, nose etc are called eigenfaces.

IV. FEATURE EXTRACTION

The next step in face emotion recognition is feature extraction. This approach extracts features of interest from frames to be processed further. The retrieved features are fed into the next stage of the process. Edge-based approach, Global and Local feature-based technique, Geometric feature-based technique, Patch-based technique, and Texture-based technique are the five types of feature extraction methods.

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Feature extraction Methods

- **Texture feature based method**

Texture refers to surface characteristics and appearance of an object or image given by the size, shape, density, arrangement, proportion of its elementary parts. Texture segmentation makes a partition of an image into a set of disjoint regions based on its properties, so that each region is homogeneous with respect to certain texture characteristics. Some of the techniques using texture feature-based method are Local Directional Number (LDN), Local Directional Ternary Pattern (LDTP), KL- transform Extended LBP (K-ELBP) and Discrete Wavelet Transform (DWT).[1]

- **Edge based method**

Edge based method initially converts the image into grey scale or gradient image. Edges typically refer to points in the image where the Gray value changes significantly from one pixel to the next. Thus, detecting Edges help in extracting useful information characteristics of the image where abrupt changes occurs. Some of the techniques used for Edge based method are Local Binary Pattern (LBP)[1][7][8], Line Edge Map (LEM), Graphics processing unit based Active Shape Model (GASM) and Histogram of Oriented Gradients (HOG).

- **Global and Local feature based method**

Global feature represents image as whole with single vector whereas local feature represents as images as patches and with local computes with multiple points on the image thus making it more robust. Some of the common techniques used for Global and Local feature based method are Principal Component Analysis (PCA) [9], Independent Component Analysis (ICA) and Stepwise Linear Discriminant Analysis (SWLDA).[1]

- **Geometric feature based method**

Geometry based feature extraction method help in identifying the shape of the face and its components, such as the mouth or the eyebrow. In this method the primary step is to localize and track a dense set of facial points. These dense sets of facial points locations called facial landmarks; are then used in different ways to extract the shape of facial features, and movement of facial features, as the expression evolves. Local Curvelet Transform (LCT) is one of the techniques for geometric feature-based extraction.

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- **Patch based method**

In the patch-based feature extraction method, the input image is divided into patches (i.e., blocks), these blocks are then manipulated separately in order to provide an estimate of the true pixel values.Wavelet energy feature extraction algorithm is used for patch-based method.

V. FACE RECOGNITION METHOD

- **Holistic method**

In this method, complete face is taken as input to recognize the individual in the face recognition system. This method works well when the image or video has a frontal face. Some of the holistic method algorithms are Principal Component Analysis, Eigenfaces, Gabor Wavelet, Hidden Markov Model, Linear Discernment Analysis and Support Vector Machine.

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- **Feature based method**

In this method, patches of a face like eyes, nose, mouth are used to recognize an individual. The problem with this method is that it recognizes an individual by only a patch or it's also called as local features. Some of the feature based methods are Scale invariant feature transform, Harris and Speeded up Robust Features.

- **Hybrid method**

This method is a combination of both the Holistic and Feature based approach. This method is most popular and widely used method.

VI. ARCHITECTURAL DIAGRAM

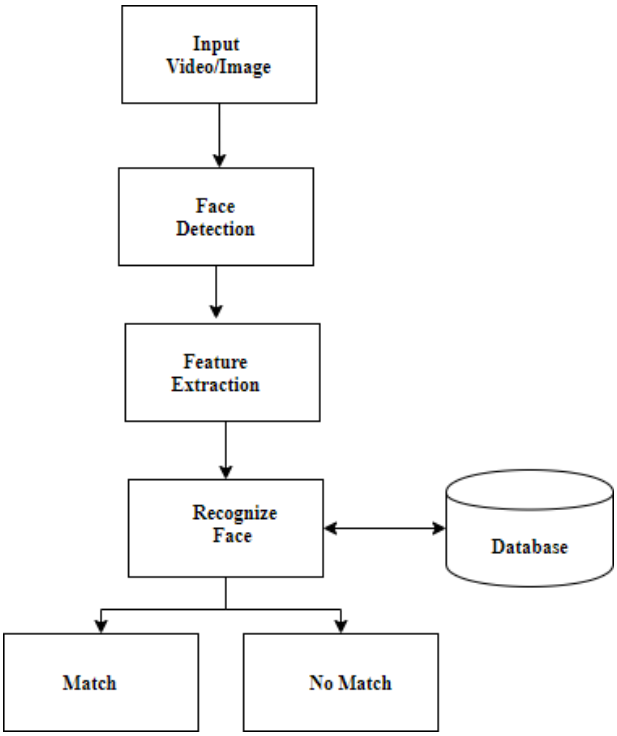

Figure 1: Face Recognition Architecture

The image is initially sent to the Face Recognition system as input, and then it is processed using a face detection algorithm, which effectively selects the faces of people from all of the images. All other picture parts are deleted, leaving only the person's faces to be selected and transferred to the next module. Local features from the faces are extracted in feature extraction, such as the nose, eye, lips structure, distance between eyes, nose length, and so on, and those features are passed to the next module, the classifier, where the actual face recognising and face matching process takes place, using various algorithms to match and compare the patterns with previous existing images in the database.

VII. CONCLUSION

Face recognition system is popular these days and its widely used in real time environment so it's necessary to have good face recognition system. This paper highlights on the steps required to recognize and match the face but as mentioned earlier there are some challenges like pose variation, change in expression, cluttered or blur image occlusion and illumination. Here, an approach for overcoming occlusion and building a stronger model for recognising faces in varied conditions was discussed. Some real-time applications, as well as technologies like MATLAB, Python, and OpenCV that can be utilised to develop a system, have been highlighted.

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