A DETAILED REVIEW ON FACE DETECTION AND RECOGNITION IN DYNAMIC PICTURES (LOW QUALITY)

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Abstract— The Face is treated as an important part of the human body and uses for the recognition of people. Face detection and recognition is a method to identify the person's face from any videos and pictures, this technology becomes an important topic in research for the application like detecting unknown faces, surveillance system and identifying the criminals. But in the identification of the face various problems like illumination, occlusions, resolution, pose variance difficulties occur. To accomplish the goal of face detection and recognition in videos or images, it is important to develop various good and accurate techniques. We have prepared this survey paper by doing a deep study on all the techniques available in face recognition and detection.

Keywords—Face Detection; Low Quality, Criminal Identification; Face Recognition;

I. INTRODUCTION

Detecting the face in videos has been widely used in every aspect of the field. The rapid growth in the technological area has led this technology to ease. In, security area, these mechanism of recognition and detection have proven to be more helpful. This technology shows the interaction between computer and human or how computer detects the human face via video or camera. This process involves many levels like detection, feature extraction, classification, and preprocessing. Many researchers have been implemented to find new algorithms for different levels. A lot of researchers have done tremendous work on static images; thus, the demand for video processing has been increased. The video processing led to detect an object or faces from video sequence or static image. This task is not very easy to do because of the various diversity or difficulties of video like lighting conditions, occlusions, variation in pose, side view face, background complexity, expression of faces, the low resolution of images. Researchers in the last few years have established various accurate possible techniques for face recognition and detection. This paper provides some analysis of techniques in detection and recognition of face together with the research gaps.

Phases includes in recognition system

There are four types of phases in the Facial Recognition System are Preprocessing, Face Detection, Face Classification, and Feature Extraction. Figure 1 presents the general procedure which is involved in the recognition system.
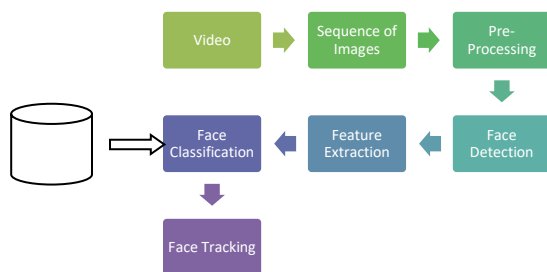

Figure 1: General Steps of a Recognition System

i) Preprocessing: - Preprocessing technique is the initial stage of any facial recognition system. In this the images are tested with the proposed algorithm. It preprocesses pictures of face to enhance the rate of face recognition. So that the variations in light condition and facial expressions cannot affect the images.

ii) Face Detection: - Detection of face is the identification of human face through algorithms. This detects the human face from the given image or video.

iii) Feature Extraction: - Feature extraction is the extraction of main features of face in facial recognition like eyes, nose, and mouth from human face.

iv) Face Classification: - Face classification is the final stage which uses the extracted facial features to identify the person.

These are the various steps in the real time of face recognition and detection system.

II. FACE DETECTION APPROACHES-

The various face detection and recognition approaches have been developed in this field. In the early years of these techniques, those techniques were mainly focused on the front side of the face but in recent years the approaches are now detecting all types of multi-view faces. Some of these approaches of face detection are recognition are given below: -

1)Viola Jones Approach-

The Viola-Jones algorithm is an object detection algorithm used for also face detection. This approach is proposed in 2001 by Viola et. al. in the year 2001. It is used to detect front face (not tilted or side-view face) or detect face from the non-human videos. This approaches also provides high detection rate. There are four main steps in this approach-

1-Selection 2-Formation 3-Training 4-Classification

The **Haar Selection feature** used to select the alike attributes like place nearly around the eyes are more black than areas near to nose, then the comparison of the attributes with Haar features which is known as digital image features, is done. Then, formation is used to increase the speed of the detection process of the image that is created. Training step picks decisive optical features after inspecting the whole set of every features that are possible. Then the group of classifiers are combined to form cascading and backgrounds are discarded so that the focus can be made on the region of face for efficient face detection.

2) AdaBoost Approach-

This approach can be utilized to boost the detection rate of the algorithm by selecting only those features who known to improve the prediction power of the model. This is widely used for boosting the detection power. This approach combines the multiple weak learner into a strong learner.

3) Template Matching Approach-

In this approach the features which are extracted from the images are templates which compared with the persons face which is stored in the database. The challenges in this approach are illumination, occlusion and background changes.

4) Eigenfaces Approach-

This Eigenface approach uses Principal Component Analysis (PCA) on the collected set of images and it results into the formation of the basis features set . The PCA applies an orthogonal conversion to find best eigenvectors and lower the dimension of features to use this approach for face detection. This approach uses simple method of evaluating the Euclidean distance between two vectors, and minimum can be classified as the closest object.

5) Neural Network based approach-

Neural network branch is now widely used for pattern recognition which is mostly used with Machine Learning. A neural network used for classification, this includes pattern recognition and sequence recognition and also novelty detection. Many models are used in neural network, for face detecting system

Henry A. Rowley, Shumeet Baluja and Takeo Kanade in the article [9] utilize neural network for detecting face. They discriminated faces in two classes one who have faces in images and those who doesn't have faces in the images. This reduces the complexity of manually selection of images which are non-face type. There are two main steps-

1.Neural network Filtering-

   In this filter component system takes input of 20x20 pixel area of an image and create an output which ranges from 1 to -1 showing whether the existence of face inside image or not.

2.Merge overlap detection

   The detection accuracy of face can be enhanced by using two different techniques, first one is union of detections from the particular networks. These detections are overlapping to each other. The second one is the process of intermediating in between the different networks.

6) Support Vector Machine (SVM) Approach-

It is an unsupervised technique in machine learning used for classification and regression analysis. SVM created by Siegelmann et. al. that can be utilized for categorizing data that are not labeled. SVM can be used to recognize right hyperplane to separate the data into two classes, data points are known as support vectors. But some points data are not that simple, these points are far off from both classes, to classify these points researchers create an equation called soft-margin hyperplane. For face detection B. Heisele, T. Poggio, M. Pontil [12] uses SVM classifier to detect the front side of faces in grey images by reducing the complexity of detection features.

P.Jonathan Phillips [24] uses SVM-based algorithm for both verification and identification, image is given to the algorithm and the algorithm also gives confidence measure of validity of correct identification.

T. Nyein, A. Nway [17] uses SVM and FaceNet to detect and recognize the faces by extracting the features from the images, FaceNet is used for embedding facial images into a dimensions of 128, for classification and compare these dimensions with the given images to recognize the faces.

Advantages and disadvantages of this approach given in the table of all samples.

7)Principal Component Analysis (PCA):

It is used for reducing dimension. In this technique, a hyperplane is selected in such a way that all points are being projected onto it, they are spreading out at maximum. In this technique, extracting of the most occurring feature available in the images (face) is done. The process of reduction dimensionality includes linear combination of weighted eigenvector are also called as Eigenfaces; these eigenvectors can be evaluated from the covariance matrix of training image set known as basis function. For recognition of faces, a new image is projected onto subspace spanned by eigenface. After that, using Euclidean distance or any other strategy is used for classification. (There are also other dimensionality techniques like as Linear Discriminant Analysis (LDA), a supervised learning and also used for face recognition but this PCA techniques works very well.)

Through the utilization of this, one can reduce the dimension of high dimensional data to the data of lower dimension by choosing maximum eigen vectors of covariance matrix and projecting it onto those eigen vectors. These vectors are the principal axes and the axes used for data projection.

In this PCA technique if the Eigen value is higher then the recognition rate will also increase, but increase in certain amount in eigenvalue the recognition rate will decreases. Increase in variety of images or number of images in the covariance matrix will increases detection rate until the images are not noisy images. If the images are noisy images the detection rate will also decreases. In other words, the size of image will not have any effect on the PCA based recognition system, Pose and expression will also have minimal

effect to the detection rate of the faces but detection rate will decrease if images have illumination conditions problems.

**Table 1: Analysis of papers on the above-mentioned approaches-**

Algorithm	Papers	Year	Dataset	Result
Viola Jones Approach	Detecting Face by the Algorithm proposed by Viola Jones through the use of Composite features	2019	FDDB dataset	Improves original Viola-Jones algo on false face detection
	Illumination invariant face detection using Viola-Jones Algo	2017	Fair and Dark colored men black & white image also considered	Improves Face detection
	Face Detection using Viola Jones Algo & Neural Network	2018	Images	Accuracy **90%**
	Reducing redundancy in in detection of face by the technique of Viola Jones and utilizing the Hill Climbing Algorithm	2020	Set of Images	Traditional VJ->accuracy 77%, precision 71%, recall 81% Improves by>accuracy **85%**, precision **95%,** recall **88%**
Eigen face Approach	Multifaces Recognition Process using Haar cascade and Eigen face method	2018	Images/group of images	Improve detection of side view and head up faces Face detection up to 200cm distance
	Application for recognizing human by utilizing PCA and Eigen face technique	2017	images	Train user 1 face detection-**99%** Train user 2 face detection-**97%** Train user 3 face detection-**98%**
SVM	Cascade detection of face based on Histogram of Oriented Gradients & Support Vector Machine	2016	images	Improved detection by **94.5%**

	Attendance system for Classroom of a University through the use of Support vector machine & FaceNet	2019	images	FaceNet and SVM overall accuracy **99.55%**	
AdaBoost Approach	Face Detection algo based on improved AdaBoost and new Haar features	2020	Set group of images	<u>Traditional</u> No of faces to be detected-450 No of face detected-458 Correctly face detected-396 Misjudged face detection-62 Detection Rate -88% False Detection Rate-13.78%	<u>Improve</u> 450 443 415 28 92.2% 6.22%
	An Optimized face detection based on AdaBoost algo	2019	images	Detection Rate-96.7% False Detection Rate-2.1%	

Merits and Demerits of the Algorithms-

S.No.	Approach	Merit	Demerit
1.	Facial Feature	Lowers the computational costs and computational complexity for feature representation.	It has high convolution costs. Dimensional feature vector is high.
2.	Skin Color Based	It is fast, robust and also has a high detection rate.	It is sensitive to face size, poses, illumination and expressions.
3.	Template Matching	It shows nice performance for tracking features which are non-rigid type. Implementation is easy.	If global minimum fit can't be found for the model, the matching will not occur. Due to the scale, pose and shape variation, it does not give accurate result for face detection.
4.	Component Based	Face detection is fast & accurate.	To increase the accuracy, more support vector is needed but it also increases computation cost.
5.	Eigen Faces	I)Implementation is east and fast. II)Includes basic steps for recognition.	It is sensitive to the head position and illumination and lightning.
6.	PCA	• Lowers the Dimensionality of the image.	• It has lower discrimination.

		• It is fast, robust & simple. • Less noisy image recognition is fast. • Basic raw data is used for training, learning and recognition.	• Face expression & position are doesn't affect the recognition. • Scale normalization is necessary because it is scale sensitive. • It consumes more time in first learning because it is appearance based.
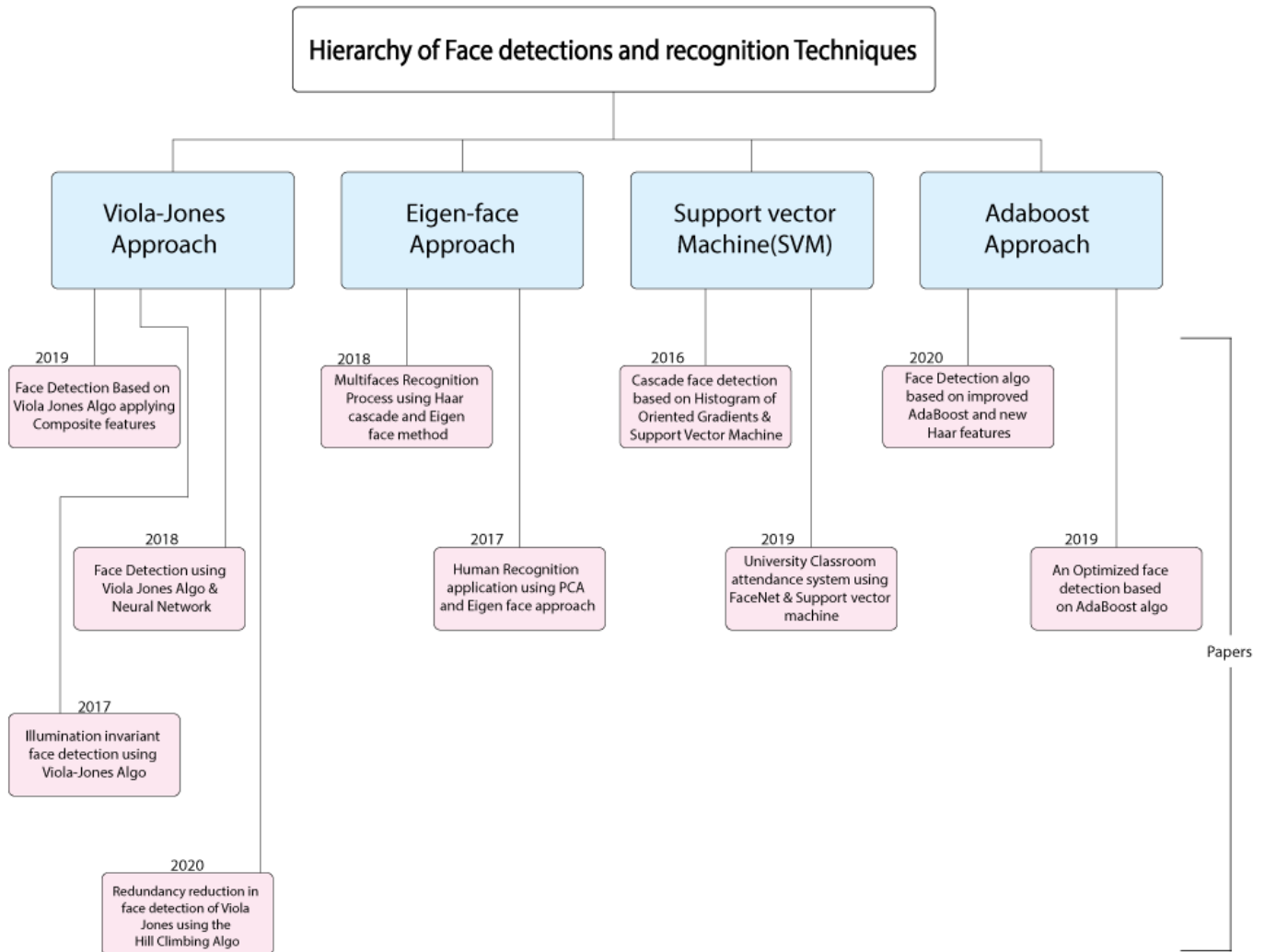
Conclusion-

Nowadays, face recognition and detection techniques are in very demand. These techniques have been applied to many areas because of its non-contact process, these techniques are accurate and easy. In this paper we have included various detection and recognition process with their outputs along with the gap in research. Future work can be face detection and recognition model which can provide more accurate as well as robust to deliver good performance.

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