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*Review Article*

# Face Recognition Techniques : An advancement in AI Industry

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***Abstract***

*The motive of the work behind face recognition techniques involves many practical applications like that of the automated surveillance of crowds, enhanced human computer interface, image based database management and autonomous criminal identification, tracking and the list goes on.*

***Key words :*** *tracking, criminal identification, automated surveillance,*



## Introduction

Building a computational model for the face recognition with an equivalent of human perception system is the current trend of the computer scientist. It will not only give several significant theoretical insights but will also give major contribution towards practical applications, which had remained a prime hitch in the domain of face recognition. The motive of the work behind face recognition techniques involves many practical applications like that of the automated surveillance of crowds, enhanced human computer interface, image based database management and autonomous criminal identification, tracking and the list goes on. Such biometric recognition techniques are often influenced by disfigured object obstructing the view plane of the face and thereby such occlusion inducing high error rates in the recognition process [1,2]. Though the face recognition technique has achieved a lot but has failed to overcome such difficulties and yet to reach high accuracy in recognition rates [3–9].

There are few strategies that we have classified into three approaches which have been used to overcome such situations [10–15]; these are enumerated as follows:

1. Principal component analysis (PCA) [16].
2. Linear discriminate analysis (LDA) [17].
3. Machine learning approach for face recognition [18].
4. Kernel machine-based discriminate analysis (KDA) [19,20].
5. Flexible discriminate analysis (FDA) [21].
6. Generalized discriminate analysis (GDA) [22].

The recognition process primarily relies on two essential features of the image i.e., global and local feature sets [23,24]. Additionally, the previous studies implied towards the usefulness of local feature sets for the facial recognition process [25–29].

There were other methods which used a mixed combination of the previously cited methods and consequently gave remarkable results corresponding to the learning based interpretation of the classifiers for feature of facial parts [30–33].

**Literature Survey: Face Recognition Techniques**

The principal approach to classify the several methods based on the type of technique used in the previous studies the classes are divided in to three; namely: feature based methods, part based methods and fractal based methods (Figure 1).

**Part Based Methods**

In this method the normalization of the image is the first step, followed by the detection of the facial area in the given image by using template matching to localize the regions. Thereby, the center of the eyes and further displacement vectors is employed as a normalization factor. The center detection and the localization of the displacement for different size of images carried through the extracted luminescence component are shown in the Figure 2. Herein, the colored image is converted into a gray-scale one using the edge converter i.e., mainly Sobel method and then latter binarized using Otsu's method [34]. The vertical integrated projection of the binary image which is smoothed out the projected profile by averaging the neighboring values [35]. The consecutive profile so formed is searched for the larger valleys peaked out comparatively higher than the rest of the projection profile. Such peaks indicated the facial feature regions such as eyes in this case and subsequently the three holding parameters are changed to follow the same procedure for other feature sets of the given facial imagery. To locate such regions various transformation methods are applied, among them Hough transformation is the preferred for such strips of binary image.

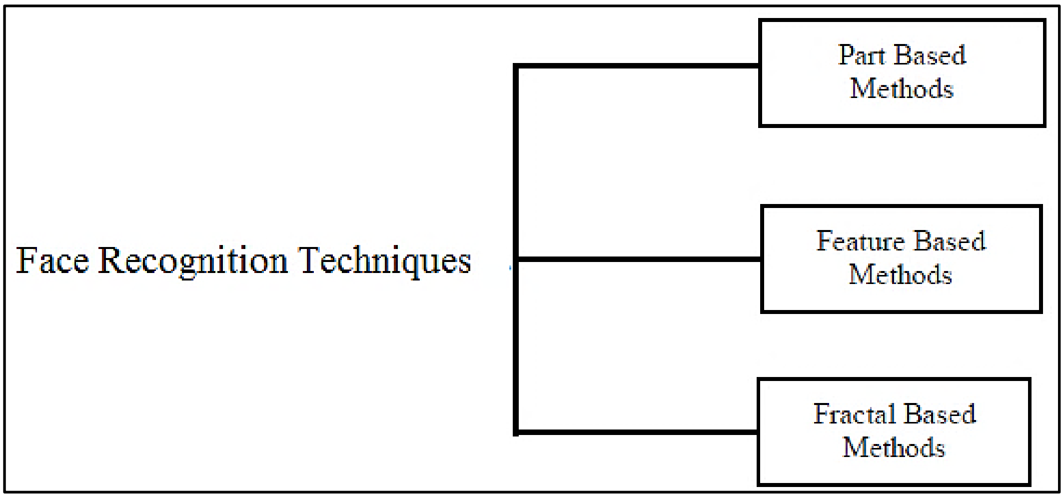


***Fig. 1:****Classified Techniques for Face Recognition in Occlude Cases.*

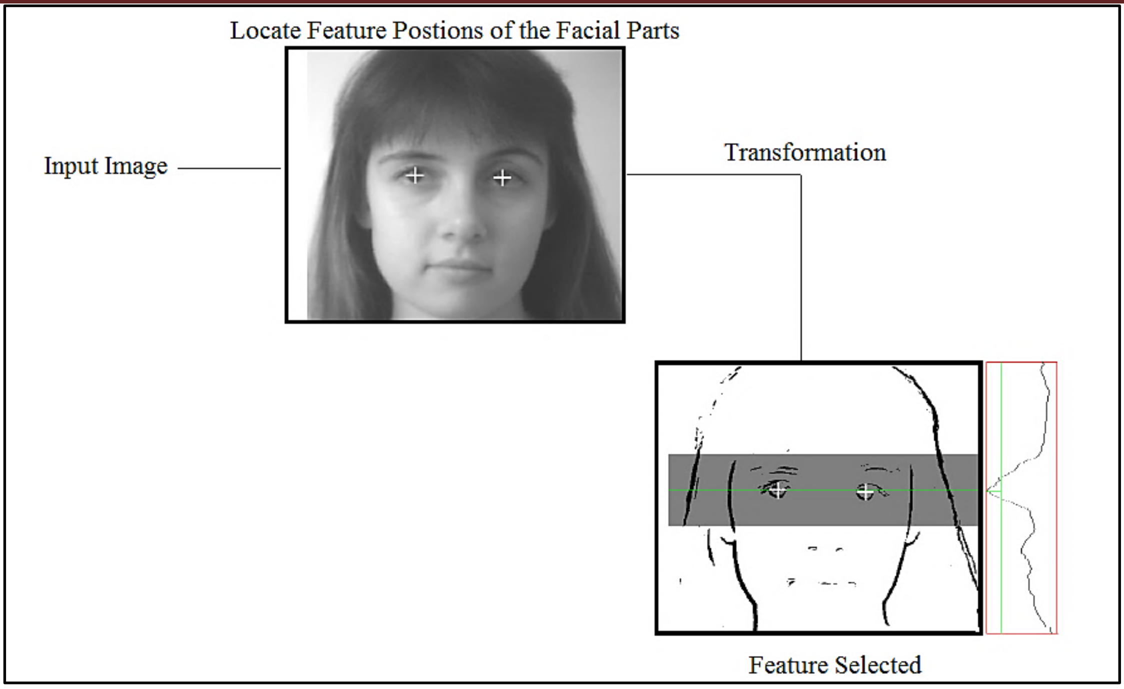


*Fig. 2:Illustration of the Facial Feature Set Recognition Using Part Based Methods.*

In the past studies, this method is speeded up by using several other masks corresponding to the different template features from the principal imagery. The output of this processing step is the coordinates of the pairs of eyes, ears, nose and mouth. To eliminate other unnecessary computation such methods are cropped, scaled and transformed before pre-processing to eliminate the background information like hair, scarfs, etc.

Since, the method is highly prone to the varying light illumination environment thus in the consequent studies that needs to be followed; the attempts should be made towards the correction of the mouth region as it is the most variant part of the face in the mentioned uncontrolled environment. With the current method of part based method we can't rely for the varying facial expression of the similar images of the same person with different micro-expressions and this process is proved efficient only when in the test cases the test person is requested to restrain from excessive facial expression.

The latter studies made in this context had removed the additional features from the original image at the gray-scale conversion using edge detection mapping Deriche algorithm and then apply the ranking transformation to change the values of every element in the edge map to derive the ranking of the corresponding edge element.

### Fractal Based Methods

The technical way to recognize the non-linear or fractal geometry of the facial parts is the encoding of geometric feature based selected points or blocks assigned for the surface are of the regional spaces in its localized facial parts. Figure 3 demonstrates the same by generating the segments, allocating perimeters, and the surface area of the facial figure formed out of the coagulated rectangular blocks.

The feature sets described the recognition results in Samal et al. [36]. It includes 20 to 25 segments between the values of the mean variant and the symmetrical pairs of the blocks. The tested different subsets of the paired blocks based region is looked for the most important features.

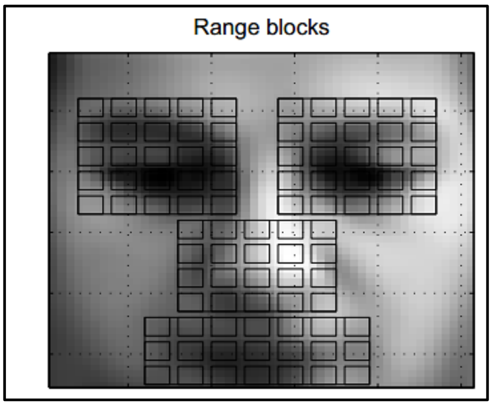


*Fig. 3: Range Block for Major Detected Subfractal Areas (Eyes, Nose, Mouth) for an Arbitrary Image.*

**The process in this method involves:**

1. Quantized the color image to 256 gray scales.
2. Image sampling of two persons is added for the test study from the requisite database.
3. Feature sets are selected based on the pairing of the total block region over facial parts.
4. Localized distances between the feature spaces is matched with the template image.
5. Following the above method the closest imagery data is derived, based on the measure of the similarity the result is deemed positive.

In spite of the other scaling, rotational, and illumination transformation in the image, this result proves to be more robust than the previously discussed method with the recognition rates of 98.5%. Although it suffers major disadvantage of manual point location and its efficiency decreases for poor quality images or when several other facial parts are occlude by hair, scarf, sunglasses etc.

Feature Based Methods

The previous approach evaluates on the fractal or part based feature sets for facial recognition which anyway inherits the same disadvantage of degrading efficiency in the uncontrolled environment. Given the condition that the variation in face recognition environment is futile to compare the original images with the variant images or its feature maps to only receive low similarity scores.

***Fig. 4:****Results of the Feature Division forFrontal Imagery of Facial Regions.*

Now, applying some elastic transformation can help to computationally encode the geometry of the texture in the uncontrolled environments with comparatively better recognition results. We have noted that with the help of rank transformations the illumination problem can be counter balanced. Furthermore to compensate for the pose variants and facial expression the studies attempted feature based method to apply non-linear wrapping of rank map with the feature maps and then compare the same with other maps. Among various other algorithms the techniques is based on the one described by Gee et al. [37].Evidently, the comparison made between the wrapped map and the other un-wrapped map yields comparatively better results than the previous ones. However, the expensive computational cost is a hindrance for such methods for being computationally viable and applicable for real time implementation. As it involves larger sets of generated localized deformation on random basis; thus the changes in the wrapping parameters for matching after every wrapping score so received during matching is achieved with greater degree of ranking similarity. The process is continued until the present score is greater than the most prominent one otherwise the handle moves over the other feature maps. When the score falls short below the predefined threshold it can be concluded that the resulted two images are delineate imagery of the persons. The method gives an overall recognition rate of the range of 92.5–98.8%; though it is yet to be compared with its competitor algorithms but we believe that its inherent property can be implemented with neural networks in the near future to make an adopted system for the automated facial recognition.

## Conclusion

The above three recognition methods give the performance range for the recognition rates of 98.5, 92.5 and 94% for the corresponding uncontrolled environments; though a comprehensive framework is yet to be build. The summation of the overall methods gives us the pros and cons of the principal methods and their approaches, though some give better results but are expensive in terms of computation and similar trade-off. Hence, after reviewing the literature and principal methods for occluded images we hope that our work will aid the researchers in accessing the heap of previously attempted methods and shall help them in evaluating its advantages and disadvantages from the same source to formulate a new method.

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