Automated Facial Expression Recognition framework for analyzing Dynamic Expression in Occluded Images

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ABSTRACT: *The automatic emotion detection method plays important role in many fields such as human computer interaction, health informatics (Depression, autism), and education (eg. Tutoring system) and driving system. The salient facial patches can be used to extract the discriminate features of the fascia and is used to identify the universal expression such as neutral, anger, disgust, fear, joy, sadness and surprise. The proposed system provides a novel framework to identify the Universal expressions along with the other subtle expressions by using the facial point tracking method. Automated facial expression recognition (AFER) algorithm is proposed to identify the dynamics of facial expression in the temporal domain. In addition, the facial expressions of the occluded images can be determined by the use of iterative face recovery and recognition by input approximation, which achieves the normalized facial appearance and thereby the expression in the face.*

Keywords: *Eigen Spaces, Feature Extraction, Occlusion, PCA method.*

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1. INTRODUCTION

The facial expression [2] is the movement of the muscles beneath the skin of the face. The facial recognition is the process of identifying the turn of phrase made by the individual. The facial expression recognition have been used in the applications like human-computer interaction, online tutoring systems, driver safety mechanisms and many other medical fields. Fascia actions are the non-verbal way to convey their reactions for the situation which may vary from time-to-time and from individual-to-individual.

An occlusion [6] is the obstruction or unwanted object that hides one object from the view of the individual. It can also be referred to as the hindrance in the view of the object. It may be difficult to match one image with that of other. When considering the facial image, the occlusion may be due to various factors such as:

- wearing sunglasses or goggles
- scarf around the face
- unwanted hair such as beard
- face behind the fence and other texture variations

The occlusion type, lighting effects and viewing direction may be the major cause of the variation in the image patterns of the face. It can be resolved by reconstructing the occluded image to obtain the occlusion-free image.

The system proposed is used to identify the facial expression in the occluded images that have been captured in the temporal domain. The system deploys Principle Component Analyzer to find the features of the fascia.

2. RELATED WORK

A. "*Local Feature Extraction Method for Facial Expression Recognition"*

In this paper the facial expression recognition is done in two stages: feature extraction and feature classification. The performance of feature extraction is analyzed by the Higher Order Auto-Correlation (HLAC) [9] and the Local Binary Pattern (LBP).The auto-correlation coefficients can be used for accuracy purpose. But on the other hand, the HLAC method discriminates from the LBP method in the complexity and time to extract the features of the face. So both methods are not used for feature extraction.

B. "Facial Action Recognition for Facial Expression Analysis From Static Face Images"

To localize the facial features the multi-detector [1] approach is used in the proposed system. This method is used to sample the profile outline and the shapes of the facial components such as mouth, eye and nose. In addition with this, 32 action units are used to detect the facial expression. The drawback of this system is that it is limited to the non-occluded images and it cannot determine the full range of facial behavior since it is limited to the frontal-view of the face.

C. "Dynamic Texture Recognition Using Local Binary Patterns with an Application to Facial Expressions"

Dynamic texture can be referred to as the advanced feature of texture in the temporal domain. The Volume Local Binary Pattern (VLBP) [5] are used to model the textures. They can also be used for the texture analysis, combining the movement and the facade. For recognizing the dynamic events, the block based method which combines the pixel values and the volume of the image is used. But the illumination variation or the lighting effects are not considered. It may also vary the facial expression. Illumination balance is also done in normalization, so it cannot be avoided.

3. PROPOSED SYSTEM

The proposed system is used to find the facial expression of the input image. The input image is given to the system. If the image is occluded then it is normalized and then the features of the fascia are obtained. If the given input image does not contain any occlusions then the facial patches or the features are extracted which is followed by the facial expression recognition.

Once the image is classified then the image is set for the process flow. The occlusion is the unwanted object that hides the fascia from recognizing the expression that is obstacle that makes it difficult to extract the feature of the face. The modules in the proposed system are:

A. *Face Detection:* When the image is given as the input, it may contain background images. This module is used to detect and separate the face from the entire image. It is also used to detect whether the image is occluded or not. The output image is then used for the other process.

B. *Normalization*: The normalization is the process of smoothing the variations in the image such as changing the input to normal size, pixel variations, lighting effects. But in this case we normalize the image to remove the occlusions such as wearing goggles, face hiding behind the fence, unwanted hair in the face. The normalization can be done by person specific normalization and recognition by input approximation method. The output of the normalization process is the occlusion free image. The facial images in the temporal domain [7] also requires the normalozation process.

C. *Feature Extraction:* The human face contains the features that vary while expressing different reactions. They are called as facial features or the action points. These are useful for the recognition of the expression given by the human. The process of separating and providing the characteristic values from the digital image provided is called as feature extraction. After extracting the features of fascia the expression of the face in the image is classified using the PCA classifier. The classification can also be done by comparing the test image set with the trained image set after obtaining the facial features.

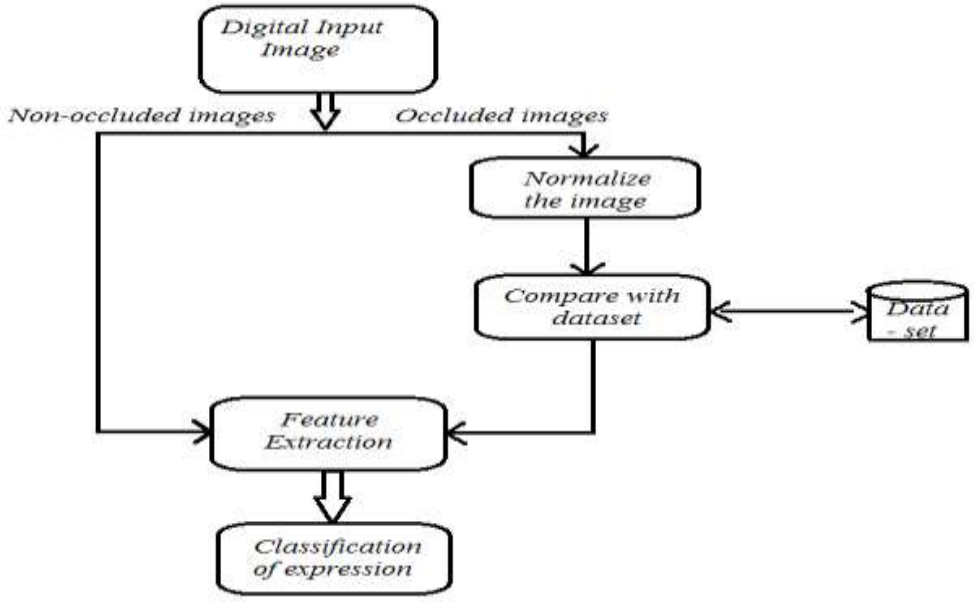

Fig.1.System Workflow

4. IMPLEMENTATION

The digital facial image is given as the input. The facial part is detected in the given image and they are separated from the background image.

For the image with occlusion the image must be normalized in order to obtain the features from them. The normalization can be done by the person specific normalozation of the facial appearance and recognition by input approximation method. Normalizing the shape and consistency of the fascia is important for the stout facial recognition. The deformation or the hinderrance of the facial parts may be due to the occlusions. This leads to the difficulty in the identification of the face. So it is necessary to normalize the facial image. The PCA algorithm is used to construct the person specific eigen space for individual person. This eigen-space becomes the input to identify different identities of the personality. Then the recognition by input approximation is done to compare the improved person specific texture with the original input person texture to modify the lighting effects and the texture modifications. The principle component analysis [8] is also used toextract the facial features. The principle components are calculated by:

$\mathbf{r}$ = a random vector of length p

do c times:

$\mathbf{s} = 0$ (a vector of length p)

for each row $\mathbf{x} \in \mathbf{X}$

$$\mathbf{s} = \mathbf{s} + (\mathbf{x} \cdot \mathbf{r})\mathbf{x}$$

$$\mathbf{r} = \frac{\mathbf{s}}{|\mathbf{s}|}$$

Return $\mathbf{r}$

The feature extraction is done to extract the salient features in the facial image. The features extracted are the action units which vary from one expression to other expression. The facial features can be obtained by the range of interest(ROI). If the range of interest is the eye, then they are selected by the rectangular box and the features such as eyebrow length, iris, distance from the eye centre and the eye corner can be determined. The other features that can be extracted are color extraction and texture extraction. Then the classifiers are used to classify the expression based on the features extracted. The euclidean distance of the features extracted are used to classify the expression. The euclidean distance of the input image and the trained image are compared in order to find the expression.

The trained data set may contain already given input images for which the person specific eigen spaces are constructed.

If the input image given is occluded image then the non-occluded image is obtained from which the expression is determined.

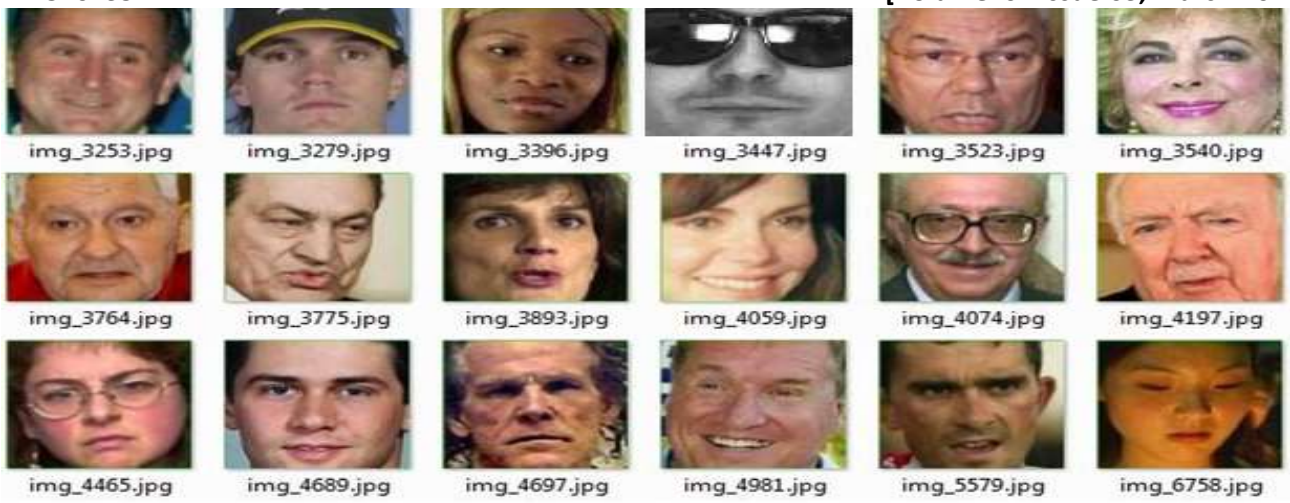

Figure2. Trained Dataset

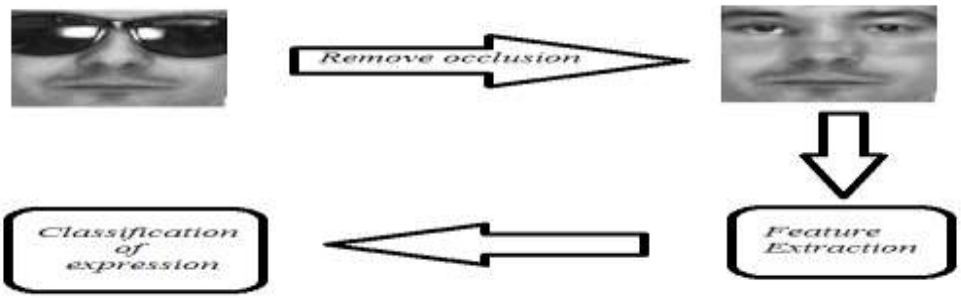

Figure.3.Implementation Proces

5. CONCLUSION

It is observed that the combination of person specific normalization method and PCA algorithm along with feature extraction in the proposed system allows the reconstruction of the occluded facial image and thereby recognizing the expression of the face. This may reduce the difficulty of identifying the expression in the systems like human-computer interaction, health informatics and others. The advantage of the proposed systemis that the subtle reactions other than the universal expressions can be determined and the facial expression in the temporal domain can be obtained.

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