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*Research Paper*

# FACIAL EXPRESSION RECOGNITION USING PROPERTY OF SYMMETRY

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Face detection is one of the challenging problems in image processing. An algorithm is used to identify the person's emotional state through facial expression such as angry, disgust, happy. A Radial Basis Function network (RBFN) for classification and Fisher's Linear Discriminant (FLD), Singular Value Decomposition (SVD) for feature selection is used. A method based on fuzzy logic reasoning strategy is proposed for edge detection in digital images without determining the threshold value. A facial expression recognition system based on Hybrid Face Regions (HFR) is investigated. Here, emphasis has been to develop a very simple and small but a very efficient, fuzzy rule based edge detection algorithm. Facial Expression gives important information about emotion of a person. Face emotion recognition is one of main applications of machine vision that widely attended in recent years. It can be used in areas of security, entertainment and Human Machine Interface (HMI).

Keywords: RBFN, FLD, SVD, HFR, Face detection, Expression recognition

## INTRODUCTION

Research on emotion detection is a very challenging field that target methods to make effective human computer interaction. Image signal contains huge amount of important information of the speaker. We use facial expressions not only to express our emotions, but also to provide important communicative cues during social interaction, such as our level of interest, our desire to take a speaking turn and a continuous feedback signaling about the understanding of the information conveyed. It is reported that facial expressions have a considerable effect on a listening interlocutor, the facial expression of a speaker accounts for about 55% of the effect of the communicated message 38% of the latter is conveyed by voice intonation and 7% by the spoken words.

This study presents a computationally efficient approach for edge detection which further leads to classification of facial expression recognition from static facial images. In the presented approach various

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algorithm are used to produce the characteristic features such as lips and eyes. Firstly the images will be loaded in the train folder and test folder. After this these images are analyzed by series of algorithms and techniques to enhance the image input, maintain intensity and removing noise from image. Second algorithm detects the edges of image. From the edge points various distances between features is calculated and Principal Component Analysis (PCA) is used for data reduction and next algorithm detects the face. On the basis of that distance emotions are recognize accurate emotions.

Another approach to face detection is based on deformable templates that use parameterized curves and surfaces to model the non-rigid features of interests, e.g., eyes, mouth of faces. The template then interacts dynamically with the input image, by altering its parameter values to minimize deformation stress in the feature. Recently, the use of neural networks or other mechanisms in face detection has been studied by many researchers.

Training a neural network or a classier for the face detection task is challenging because of the difficulty in characterizing prototypical non-face images. Set of non-faces so as to force the network or the classier to learn the precise boundary between face and non-face image is a very demanding problem.

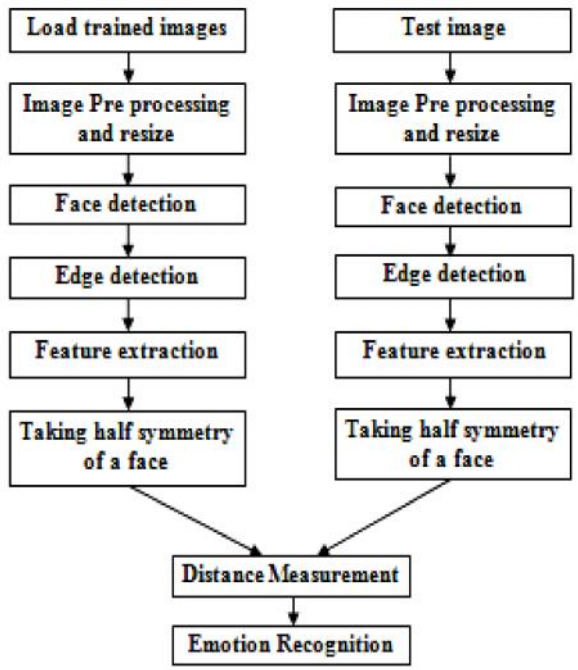
## PROPOSED METHODOLOGY

The functional block diagram of the facial expression recognition system is shown in Figure 2. Typically an automated face expression recognition system includes a camera for capturing the facial image. It is then pre processed so as to minimize the environmental and other variations in the image. This includes the operations of image scaling and brightness adjustment. After that face, mouth and eye region was detected i.e. feature extraction. Then with the help of eyes and lips feature we classify five different emotions.

Firstly, the images in which the expressions to be detected are loaded. Secondly, the loaded images are processed using Image pre-processing block and edge detection in order to minimize the environmental and other variations in the image. Later, the features are extracted and only the face region is detected in the overall image by eliminating the background and finally the distance is measured for recognizing the emotions. Figure below shows the functional block diagram of the proposed methodology.

Figure 1: Original Image

Figure 2: Functional Block Diagram for Proposed Methodology




## Image Pre-Processing and Resize Image Acquisition

The image pre-processing procedure is a very important step in the facial expression recognition task. The aim of the pre-processing phase is to obtain images which have normalized intensity, uniform size and shape. Finally, the images were scaled to the same size of 128 × 128 pixels. Figure 2 shows examples of images after the pre-processing.

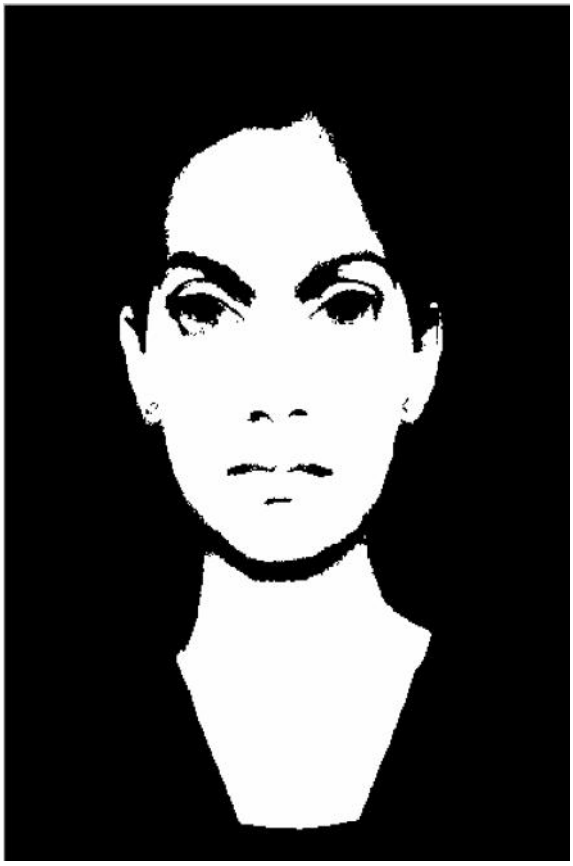
## Color Space Transformation and Lighting Compensation

In order to apply to the real-time system, we adopt skin-color detection as the first step of face detection. Due to YCbCr color space transform is faster than other approaches (Facial Expression Recognition Using Neural Networks and Log-Gabor Filters, 2008). We select this transform to detect human skin. However, the luminance of every image is different. It results that every image has different color distribution. Therefore, our lighting compensation is based on luminance to modulate the range of skin-color distribution. First, we compute the average luminance $Y_{aveg}$ of input image.

$$Y_{aveg} = Y_{i,j} \quad ...(1)$$

where $Y_{i,j}$ = 0.3 R + 0.6 G + 0.1 B, $Y_{i,j}$ is normalized to the range (0,255), and $i$, $j$ are the index of pixel.

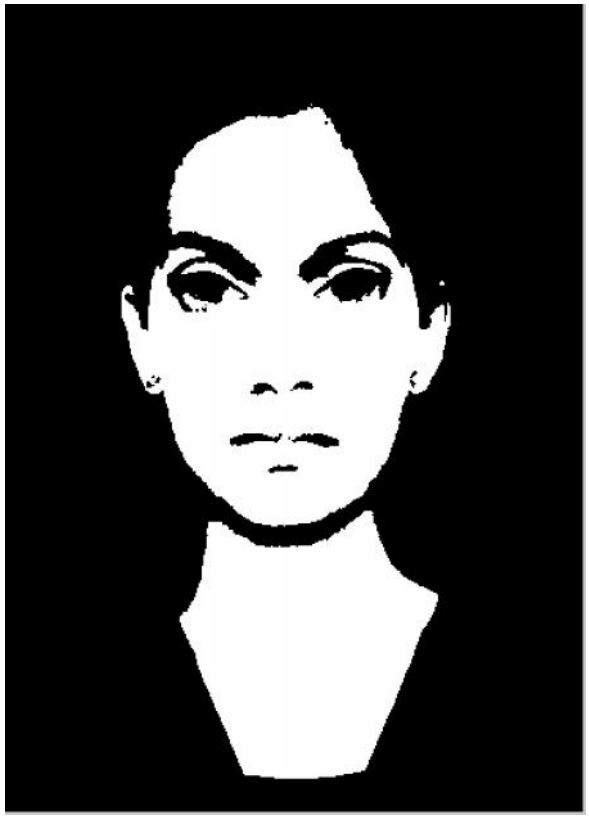
Figure 3: Result of Pre-Processing Step



## High Frequency Noisy Removing

Noise is removed by using noise removal algorithm. The algorithm is implemented in MATLAB. The result of noise removal is shown in the Figure 4.

Figure 4: Result After Noise Removal



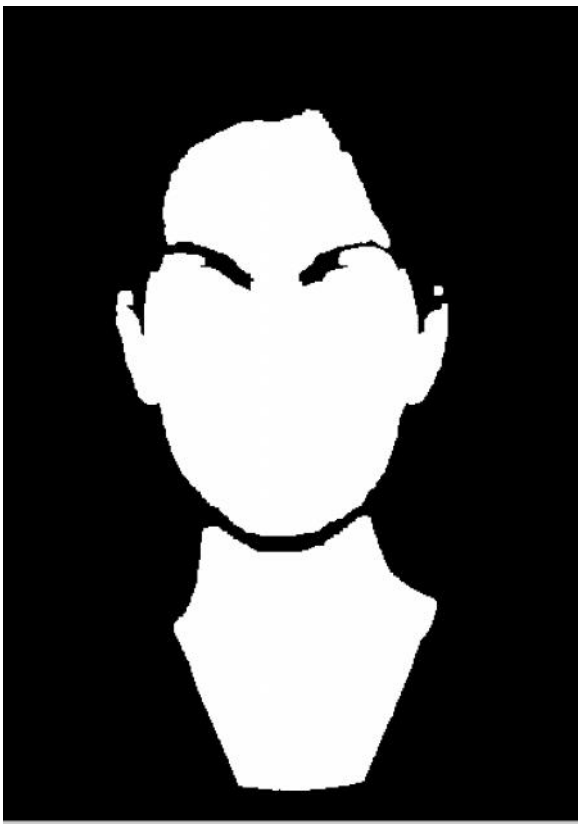
## Face Detection

Face localization aims to determine the image position of a single face; this is a simplified detection problem with the assumption that an input image contains only one face. Face detection is tricky since faces can have a vast assortment in terms of shape, color, size or texture (Ritesh Vyas and Gourav Garg, 2012). At present time a lot of automatic approaches involve detecting faces in an image. By using threshold to separate skin region from an image for face detection was chosen in this algorithm.

## Find Skin Color Blocks

There are several skin color regions in human face. In order to mark these regions we store four vertices of rectangle or every region. First, find the leftmost, rightmost, upmost and lowermost points. By these four points a rectangle is created around this region. Thus several skin color blocks called candidate blocks are found (Smith, 2002). The results are shown in Figure 5.

Figure 5: Result of Face Detection



## Edge Detection and Size Reduction

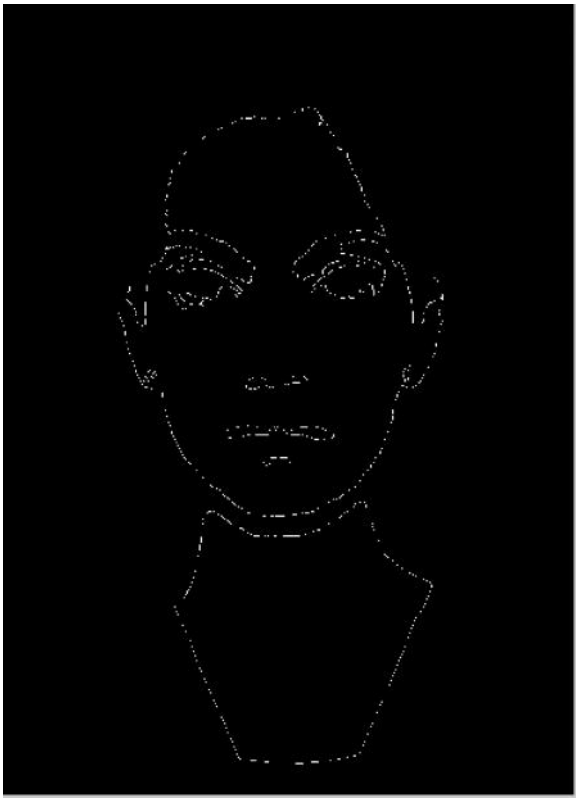
### Edge Detection

Edges are detected by using commands of image processing tool box in MATLAB. Through edges we got end point of features from the images like eyes and lips. The results of edge detection are shown in Figure 6.

### Size Reduction

A technique now commonly used for dimensionality reduction in computer vision

Figure 6: Results of Edge Detection



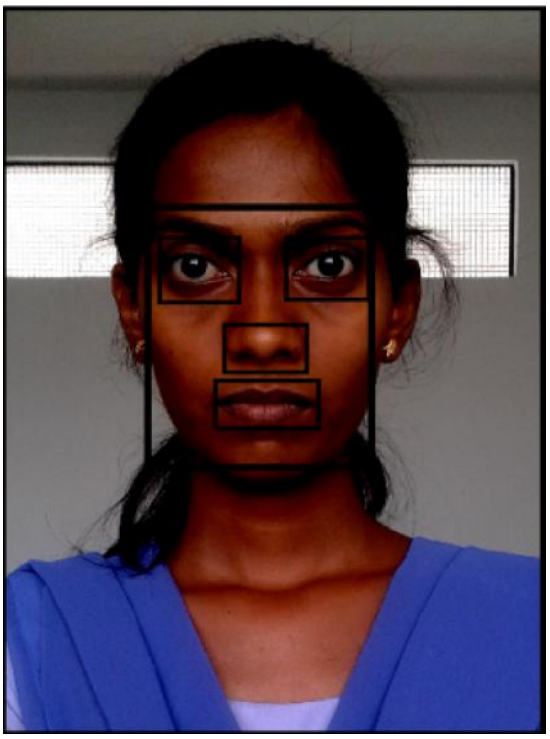
particularly in face recognition is Principal Components Analysis (PCA). PCA techniques choose a dimensionality reducing linear projection that maximizes the scatter of all projected samples. The feature vectors were normalized to zero mean and further compressed using a linear data reduction method called the Principal Component Analysis. The PCA is an orthogonal linear transformation that transforms the data to a new coordinate system such that the variance by any projection of the data is the largest forth first coordinate and then decreases along coordinates reaching the smallest value for the last coordinate. Assuming that the high variance of the data describes interesting dynamics and that low variances are linked to noise, the reduction of data dimensionality can be achieved by keeping high order principal components and ignoring lower-order ones.

## Face Feature Extraction

One common method is to extract the shape of the eyes, nose, mouth and chin, and then distinguish the faces by distance and scale of those organs. The selection face features is crucial to face recognition. To locate vital feature property of angle invariance is used (Turk and Pentland, 1991). The five features points have been used, all features are in the form of distance.

1. Feature 1 width of left eye
2. Feature 2 width of right eye
3. Feature 3 width of nose
4. Feature 4 widths of mouth corners
5. Feature 5 width of face

Figure 7: Shows 5 Vital Features



These features help in recognition of emotions. Every emotion has different values of feature vectors (Yu-Ting Pai *et al.*, 2006). The value of feature vector represents absolute between features points. Figure 8 shows the half symmetry of the detected face and then the further calculations are carried out using Euclidean distance formula.

Figure 8: Result of Half Symmetry

### Distance Measurement

#### Euclidean Distance

If the features have n-dimensions then the generalized Euclidean distance formula between the feature points is given by

Euclidean Distance, ($u$, $v$)

$$= \sqrt{(x_1 - y_1)^2 + (x_2 - y_2)^2 + \ldots + (x_n - y_n)^2}$$

In this way we also calculate other distances between any features points.

### Emotion Recognition

The recognition of emotions is based on the calculation of distances between various features points. In this step comparison between distances of testing image and neutral image is done and also it selects the best possible match of testing image from train folder. It also classifies or recognises the emotions on the basis other distances calculated. And the final results are displayed. In final results best match from training images is also shown and a text file Result.txt is displayed in MATLAB window.

## CONCLUSION

An accurate and high speed emotion detection system is discussed. The color and feature-based detections were adopted to find skin-color fast and selected candidate blocks carefully. Lighting compensation is used to improve the performance of color-based scheme, and reduce the computation of feature-based scheme. The major contribution is that the proposed method can detect edges of the images and from that edges distance between various features is calculated by using Euclidean distance Formulae. This distance is different for every image posing different emotions. On the basis of this distance emotions are classified.

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