



IDENTIFY AND EXTRACT MOUTH REGION FROM FACIAL EXPRESSIONS USING IMAGE PROCESSING SEGMENTATION TECHNIQUES

Dr. P. VimalKumar¹, Dr. C. Balasubramanian²

¹Associate Professor, Department of Computer Science and Engineering, PSRR College of Engineering, Sivakasi, Virudhunagar Dist.

²Professor, Department of Computer Science and Engineering, P.S.R Engineering College, Sivakasi, Virudhunagar Dist.

Abstract

The process of determining a human emotion, usually from facial expressions, is known as emotion recognition. There are various facial expressions, including those of happiness, sadness, fear, disgust, surprise, and anger. This research proposes an image processing method to identify different types of facial expressions from regions around the mouth. Using the Viola-Jones technique, the mouth regions are first found and then cropped. The mouth region is then segmented using Region Based Segmentation. To extract the mouth region's border, morphological area filling and boundary extraction techniques are used. The shape and size properties are preserved because morphological techniques are applied. The range of values for each emotion is then determined, and the area of the mouth region is computed based on the quantity of white pixels retrieved. The proposed method is used to two distinct people's varied emotional representations (natural, joyful, furious, and surprised). Their performances are assessed and the outcomes are examined.

Keywords: Morphological area Extraction, Feature Extraction, Emotion recognition and Detection, Viola-Jones, Region Based Segmentation.

1. Introduction

Emotion is a mental state which involves a lot of behaviors, actions, events, opinion and feelings. The six types of emotions recognized are:

Joy - The emotion evoked by wellbeing, achievement, or good fortune or by the prospect of possessing what one desires: pleasure: the expression or exhibition of such emotion.

Sadness - Sadness is an emotional pain associated with, or characterized by, feelings of difficulty, loss, depression, grief, helplessness, frustration and trouble. An individual experiencing sadness may become silent or lethargic, and withdraw themselves from others.

Anger - Anger can occur when a person feels their personal boundaries are being or going to be violated.

Surprise - Surprise is defined as to cause of someone to feel in wonderful feelings.

Disgust - Disgust is an emotional response of revulsion to something considered offensive, distasteful, or unpleasant.

Fear - Fear is a feeling induced by perceived danger or threat that occurs in certain types of organisms, which causes a change in metabolic and organ functions and ultimately a change in behavior, such as fleeing, hiding, or freezing from perceived traumatic events.

The basic facial expressions of a human image are shown in Fig 1.

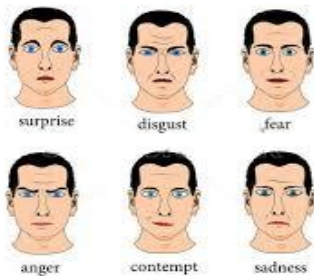


Fig 1. Basic Facial Expressions of a Person

Emotional aspects have huge impact on social intelligence like communication understanding, decision making and also helps in understanding the behavioral aspect of human. Emotion recognition is carried out in various ways as follows:

- Verbal- communicates with others by using words or noises to get your message across to the person.
- Non-verbal- communicates with others by using sign language or simple hand movements and also body language such as facial gestures and eye.

Analysis of facial expression has many applications like Human Computer Interaction (HCI), Social Robot, Animation, Alert System & Pain monitoring for patients.

In this paper, a novel method to recognize emotions from mouth regions is proposed. The major contribution of this paper is the

segmentation of images, particularly the mouth regions from the face images. It discusses and comprises the Viola-Jones algorithm and Image Cropping to locate the mouth regions and Region Based Segmentation technique is applied to extract the mouth regions. Edge Based techniques and Morphological operations are used to extract the boundary of the mouth region. After the mouth region extraction, the facial emotions are recognized based on the count of white pixel values.

2. Literature Survey

Manasa B Dr. Shrinivasa Naika C.L. (2016) et al., proposed facial expression recognition technique to recognize Japanese Female facial Expressions. The Eye and Mouth regions are extracted by applying image segmentation techniques and mainly three expressions such as furious, normal and disgust only are concentrated. [1].

Yapa Ashok and Dr.Dasari Subba Rao (2016) et al, proposed the Principal Component Analysis (PCA) technique to identify various facial expressions such as happy, sad, neutral, anger, disgust, fear etc. The PCA based methods provide better face recognition with low error rates and they are good to identify faces fairly well with varying illuminations and facial expressions etc [2].

Deepika Ishwar (2015) et al., presented “Emotion Detection Using Facial Expression” is a simple approach for recognition of the facial expression analysis. The algorithm is performed two major steps: one is a detection of Facial Region with Skin Color Segmentation and calculation of feature-map for extracting two interested regions focused on eye and mouth. And the other is a verification of the facial emotion of characteristic features with the Bezier curve and the Hausdorff distance. This can be done with different age group of people with different situation. Principal Component Analysis (PCA) used for Facial Expression

Recognition and Bezier Curve Algorithm used for feature selection [3].

Prasad M (2014) et al., proposed a technique to recognize Japanese Female facial Expressions. Facial expressions recognized based on mouth features using Susan edge detector. Face part gmented from the face image, in which mouth feature is separated and potential geometrical features are used for the determination of facial expression such as surprise, neutral, sad and happy [4].

Monika Dubey (2016) et al., presented “Automatic Emotion Recognition Using Facial Expression: A Review” a brief introduction towards techniques, application and challenges of automatic emotion recognition system [5].

Rohini Patil (2014) et al., presented “Automatic face emotion recognition and classification using Genetic Algorithm” to automatic emotion recognition and classification method is based on genetic algorithm and on neural network. This system consists of three steps which automatically detect the face emotion image: First, pre-processing such as adjusting contrast, color segmentation, filtering, and edge detection is applied on the input image. Secondly, features are extracted with projection profile method due to high speed which has taken as processed input image. Finally, in third stage to compute optimized parameters of eyes and lip through the GA, then emotions (neutral, happy, sad, dislike, angry, surprise and fear) is classified using Artificial Neural Network. The proposed system is tested on a face emotion image. The obtained results show that better performance of genetic algorithm along with neural network [6].

Siya C Sover (2015) et al., presented “Various Emotion Detection from Human Face Using Artificial Neural Network (ANN)” to automatically recognize the emotions on a face like happy, sad and anger. Face images are given as input to the system. First, face detected from input image. After the face detection, feature extraction method is used to extract the set of selected feature points. Finally, the extracted features are given as input to the neural network to recognize the emotions [7].

3. PROPOSED METHODOLOGY

Three parts of the research method are included in the procedure: preprocessing, mouth region segmentation, and emotion extraction. Images of two people with distinct facial expressions are collected as input. The flow diagram of the proposed work is shown in fig 2.

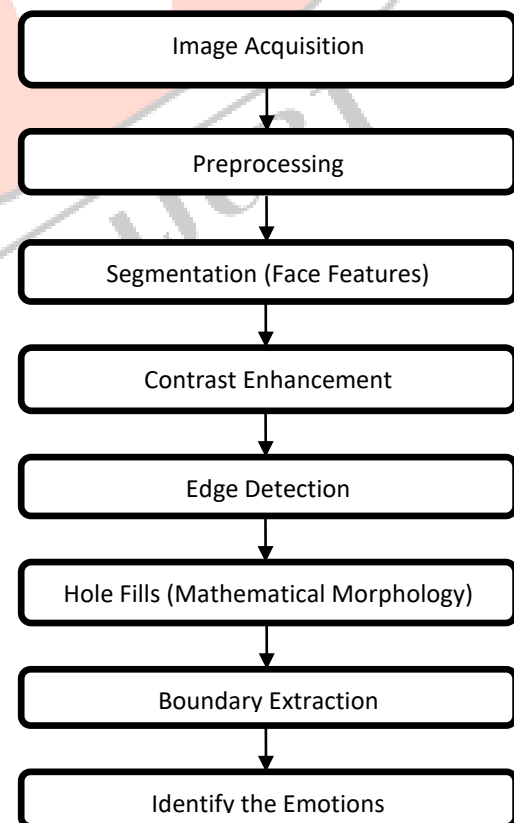


Fig 2. Schematic Diagram**3.1. Image Acquisition**

The first stage in any vision system is the image acquisition stage. The facial expression images are captured using a digital camera and a sample input face expression image is shown in Fig 3.

**Fig 3. Input Face Expression Image****3.2. Preprocessing**

During image acquisition, the input image may be corrupted due various illumination and lightening conditions. The undesired particles from the image are eliminated by applying Median filters

3.2.1. Median Filtering

Median filter is a simple and powerful non-linear filter. It can reduce certain type of random noise with less blurring than the linear smoothing filters of smaller size. Median filter provides an excellent result when applying to an image with salt and pepper noise the pixel values are arranged in an order and they are replaced with the median value as below.

$$f(x, y) = \text{median}\{g(s, t)\}, \dots\dots\dots$$

(1)

Preprocessed face expression image is shown in Fig 4.

**Fig 4. Preprocessed Face Expression Image****3.3. Mouth Region Segmentation**

From the preprocessed image, the techniques namely Viola-Jones, Cropping, Region based segmentation are applied to segment the mouth region alone from the input image.

3.3.1 Viola-Jones

The first object detection framework called Viola-Jones technique was proposed in 2001. Though it was trained to detect a variety of object classes, initially it was used for face detection. In this paper, this algorithm used to detect the mouth region from the preprocessed image. The Mouth region is identified by the rectangle box. The mouth region detected is shown in Fig 5.

**Fig 5. Detected Mouth Region****3.3.2 Cropping method**

The detected mouth region extracted is cropped for further processing using imcrop () function and shown in Fig 6.

**Fig 6. Cropped Mouth Region**

3.3.3 Region Based Segmentation

The cropped mouth region contains some background skin color which can be eliminated and region alone can be extracted by Region based Segmentation. Region growing is a simple region based image segmentation method which involves selection of initial seed points to segment the mouth region. The roi() function is applied to extract the mouth region from the preprocessed image. The segmented Mouth region is shown in Fig 7.



Fig 7. Mouth Region

The mouth regions extracted from various emotional images are displayed in Table 1.

TABLE I: Outputs of Segmentation Techniques

s.no	Input Image	Noise Remove Image	Viola-Jones	Cropping	Region Based
1.					
2.					
3.					
4.					

s.no	Input image	Noise Remove Image	Viola-Jones	Cropping	Region Based
1.					
2.					
3.					
4.					

The main drawback of Viola Jones algorithm is that the mouth detect parameter value to locate mouth region is to be changed every time. The mouth region is not detected clearly by the region based segmentation and manual selection of seed point is required. Cropping method gives better results compared to other two techniques it can be further processed to extract the emotions.

3.4. Emotion Extraction

After extracting the mouth region, it has enhanced and the boundary of the region is extracted by the Edge Based techniques. Morphological Region Filling is applied to fill the holes in the mouth region and the

outer boundary alone will be extracted by the Boundary Extraction method.

3.4.1. Contrast Enhancement

Contrast Enhancement technique is applied to enhance the color of the mouth region of the cropped image to highlight the mouth region alone and shown in Fig 8.



Fig 8. Contrast Stretching Image

3.4.2. Edge Based Techniques

After enhancing the color of the mouth region Canny's edge detector is used to extract the edges and the output is shown in Fig 9.



Fig 9. Edge Segmentation Image

3.4.3. Mathematical Morphology

Morphological Region filling and Boundary extraction operations are applied to extract the shape and size of the mouth regions.

i. Region Filling

After the edge based segmentation, the holes in the mouth region are extracted by region filling. The Region filling function is given below.

$$BW2 = \text{imfill}(BW, 'holes') \quad \dots\dots\dots (2)$$



Fig 10. Region Filling Image

ii. Boundary Extraction

After the mouth region filling, boundary extract method is applied to extract the mouth's outer region. Boundary extracted image is shown in Fig 11.



Fig 11. Boundary Extraction Image

After the mouth region is extracted, the facial emotions are recognized based on the number of white pixel in it. The proposed technique is applied on the images of two different persons with the four emotions (Natural, Happy, Furious, and Surprise) and mouth regions extracted for these images are shown in Table II.

Table II: Extracted Mouth Regions.

Original Image	Noise remove Image	Cropping Image	Contrast Enhancement	Edge based techniques	Hole fills	Boundary Extraction

3.5. Feature Extraction

For the extracted mouth regions, the area is calculated by counting the number of white pixel values. The sample code is given below.

```
area1 = sum (Bw2 (:));
Area=area1*0.264583333(pixel size);
Display (round (Area));
```

The range of mouth area values for the emotions Natural, Furious, Happy and Surprise are given in Table III and are also plotted in fig 12. If the range of mouth area is within 13 to 22 then the emotion detected is a Natural image. If the range is within 23 to 29 the emotion detected is furious. If the range is 33 to 40 then the emotion is Happy and finally the emotion detected is Surprise for the range 50 to 60.

TABLE III: Range Of Mouth Area Values

Emotions		Mouth Area	
S.no	Expression	Min	Max
1	Natural	10	25
2	Furious	20	29
3	Happy	34	46
4	Surprise	48	60

Original Image	Noise remove Image	Cropping Image	Contrast Enhancement	Edge based techniques	Hole fills	Boundary Extraction

Original Image	Noise remove Image	Cropping Image	Mouth Region	Expression

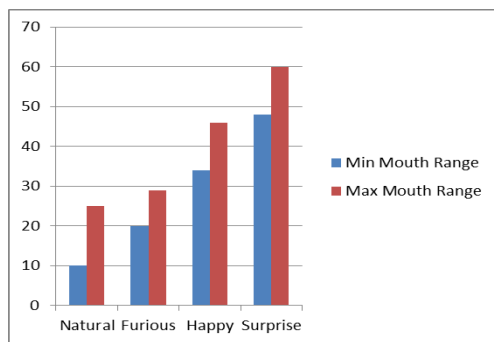


Fig 12. Comparison of Mouth area values

4. Experimental Results and Analysis

In this paper, the facial expression images of two heroines with different emotions. The mouth regions from the images are detected and based on the number of white pixels the area is calculated. With reference to the Table III the emotions are identified. The outputs of the proposed system are shown in Table IV.

Original Image	Noise remove Image	Cropping Image	Boundary Extraction	Expression

5. Conclusion

In this paper is focused to detect the expressions from the facial images by extracting the mouth regions. Mouth region is detected by means of Viola Jones, image cropping and region based segmentation. Then Edge based

segmentation and Morphological operations applied to extract the mouth region. By calculating the area of the mouth region and from the shape and size region the expression is detected. The facial images of two different persons are taken and the results are evaluated. In future this research work may be extended to identify the emotions from other parts of the face.

References

[1] Manasa B, Dr. Shrinivasa Naika C. L. "Segmentation of Human Facial Features" International Journal of Advanced Research in Computer Science and Software Engineering Volume 6, Issue 4, April 2016.

[2] Yapa Ashok and Dr.dasari Subba Rao, "Face Recognition and Facial Expression Identification Using PCA" International Journal & Magazine Of Engineering Technology, Management And Research Oct 2016.

[3] Deepika Ishwar, Dr. Bhupesh Kumar Singh, "Emotion Detection Using Facial Expression", International Journal of Emerging Research in Management & Technology ISSN: 2278-9359 (Volume-4, Issue-6), June 2015.

[4] Prasad M , Ajit Danti "Classification of Human Facial Expression based on Mouth Feature using SUSAN Edge Operator" International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 12, December 2014.

[5] Monika Dubey, Prof. Lokesh Singh, "Automatic Emotion Recognition Using Facial Expression" International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 02 | Feb-2016.

[6] Rohini Patil, C.G.Patil, "Automatic face emotion recognition and classification using Genetic Algorithm", IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) e-ISSN: 2278-1676, p-ISSN:

2320-3331, Volume 9, Issue 5 Ver. II (Sep – Oct. 2014).

[7] Siya C Sover, Beena M V, “Various Emotion Detection from Human Face Using Artificial Neural Network (ANN)” 2015 IJEDR | Volume 3, Issue 3 | ISSN: 2321-9939.

[8] Akanksha Manuj Supriya Agrawal, “Automated Human Facial Expression and Emotion Detection” International Journal of Computer Applications (0975 – 8887) Volume 110 – No. 2, January 2015.

