Analysis of Facial Paralysis Disease using Image Processing Technique

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ABSTRACT
Facial paralysis is a disease that occurs due to the disorder of neuromuscular system. It may affect on one or both sides of the face. Facial paralysis will lead to significant physical and functional hurt to patients. To diagnose the disease, degree of facial paralysis has to be evaluated. The proposed method is to evaluate the degree of facial paralysis by using IECM algorithm. The initial stages of diseases are detected by analyzing the various facial expressions. The proposed method includes preprocessing of images and estimation of level of diseases. The proposed algorithm measures the distance between the eye brows to infra orbital. It also measures the distance between the edges of mouth and lateral canthus. Diseases levels are identified as Normal, mild and severe by using the estimated parameters.

General Terms
Facial paralysis, left and right face, IECM Algorithm.

Keywords
Infraorbital, Eyebrow, Lateral Canthus and Mouth edge.

1. INTRODUCTION
The facial motor system is responsible for various facial expressions like conveying conversational signal and intimating human information[6]. Any dysfunction in the facial motor system will results in the deficits of facial expressions. Injury of seventh carnial nerve will lead to facial paralysis. This diseases results in the deformity of face and intricacies in the daily living such as taking food, drinking and communicating with others[3]. Due to facial paralysis the corners of the mouth and eyebrows are drooped. Voice timbres are also affected. Toronto facial grading system(TFGS), facial nerve function index(FNFI), Linear measurement index(LMI), House-Brackmann(H-B) system and Nottingham system are the methods used to evaluate the degree of facial paralysis[14]. Figure 1 shows the block diagram of proposed system.

2. PRE-PROCESSING
Input image is subjected to preprocessing stage. Preprocessing of image includes filtering, morphological process and image dilations. Eyebrows, infraorbital, mouth edges and lateral canthus are extracted in stages.

2.1 Median filter
The filter is used to reduce the unwanted noises in the image. The median filter is preferred over the other filters. Optimal results are obtained after applying the median filter to the image. The median filters are used to provide the efficient filter for facial paralysis. It estimates the information from one pixel to another neighborhood pixel. Even the smaller noise information's are filtered by using this median filter. It uniformly filters the information for low, medium and large signals.

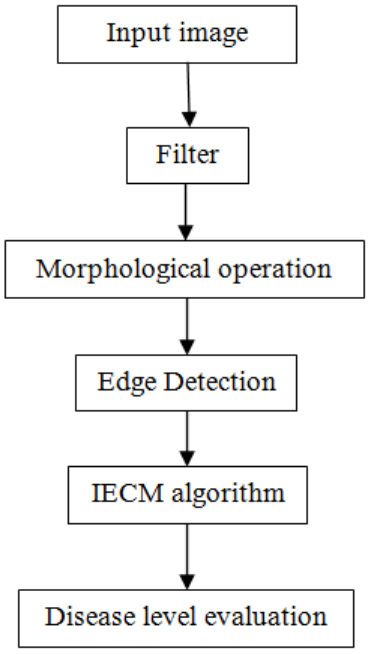

Fig 1: Block diagram

2.2 Morphological Dilation
Morphological processing is constructed with the operations on sets of pixels. Using dilation, the original image is converted into binary image. Dilation uses structuring element for image conversion process.

2.3 Edge detection
Edges often occur at points where there is a large variation in the luminance values in an image, and consequently they often indicate the edges, or occluding boundaries of the image. There are various types of edge detectors are available like sobel, robert, prewitt, log. In the proposed method, the canny edge detection technique gives out efficient edges of eyebrow and mouth edges as compared with other techniques.[9] In Canny edge detection before trying to locate a mouth edge and eyebrow, unwanted noise present in the image should be removed[2]. For filtering the noise the, Gaussian filter with suitable iteration was selected by

experimentally and noise was eliminated. At the same time by using sobel edge detection is used to find the edges of lateral canthus and infraorbital.

2.4 IECM algorithm

IECM algorithm is used to place the landmark points on the centre of eyebrows, centre of infraorbital, mouth edges and lateral canthus for various facial expressions. For normal person, the landmark points on the both sides of face should be horizontally straight, but for the paralyzed affected person it will not be straight. This algorithm calculates the distance between the various landmark points as follows

Step 1:

Distance between centre of eyebrows (CE) and centre of infraorbital (CI) is measured while eyebrows are raised.

Step 2:

Distance between centre of eye brows (CE) and centre of infraorbital (CI) is measured while eyes are closed tightly.

Step 3:

Distance between the edges of the mouth (ME) and lateral canthus (EC) while opening the mouth.

Step4:

During the facial expression like screwing of nose, distances between edges of the mouth (ME) and external canthus (EC) are calculated.

Based on the result the diseases level is evaluated. Figure 2 shows the paralysis affected image.

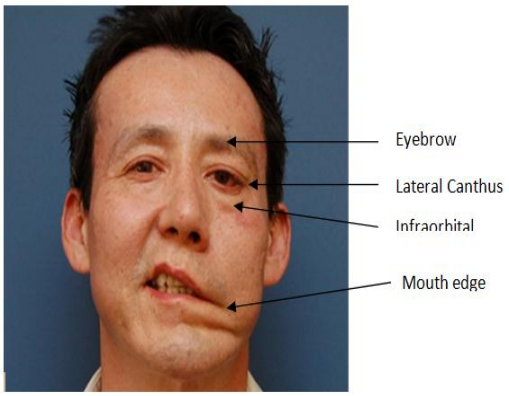

Fig 2: Paralysis Affected Image

3. EXPERIMENTAL RESULTS

Images are selected based on the human under normal and different expressions. Figure 3, 4, 5 & 6 shows the various facial expressions like eye brow raised, eyes closed tightly, Mouth opened, Screwing Nose. From this expressions diseases affected level can be calculated.

The table 1, 2, 3 and 5 show the experimental results of the proposed method. The table 4 shows the diseases level of person-1. In the result, the person 1 is affected with degree of disease less than 1 and disease level is classified as mild. Finally the graphical screen displays the person-1 diseases level as mild, shown in the Figure 4. The table-6 compares the exiting facial parameter results with the proposed technique and the corresponding graphical plot is shown in Fig.8

Table 1. Calculated distance Eyebrow raised

Person	Eyebrow raised			
	Left		Right	
	CE	CI	CE	CI
Person- 1	(16,13)	(18,52)	(71,10)	(72,44)
Person-2	(14,9)	(18,5)	(80,2)	(80,43)
Person-3	(19,13)	(21,50)	(78,10)	(76,47)

Table 2. Calculated distance Eyes closed tightly

Person	Eyes closed tightly			
	Left		Left	
	CE	CE	CE	CE
Person- 1	(20,12)	(20,12)	(20,12)	(20,12)
Person-2	(15,8)	(15,8)	(15,8)	(15,8)
Person-3	(23,10)	(23,10)	(23,10)	(23,10)

Table 3. Calculated distance mouth opened

Person	Mouth opened			
	Left		Left	
	ME	ME	ME	ME
Person- 1	(35,87)	(35,87)	(35,87)	(35,87)
Person-2	(34,84)	(34,84)	(34,84)	(34,84)
Person-3	(38,80)	(38,80)	(38,80)	(38,80)

Table 4. Disease level of patient-

Expressions	Left	Right
Eyebrow raised	(2,37)	(2,37)
Eyes closely tightly	(2,40)	(1,37)
Mouth opened	(27,69)	(18,58)
Screwing nose	(22,52)	(22,46)
Total	(53,198)	(43,178)
Current Threshold	0.898	0.811

Table 5. Calculated distance Screwing nose

Person	Screwing nose			
	Left		Left	
	ME	ME	ME	ME
Person-1	(34,61)	(34,61)	(34,61)	(34,61)
Person-2	(31,89)	(31,89)	(31,89)	(31,89)
Person-3	(33,81)	(33,81)	(33,81)	(33,81)

Fig 4: Eyes closed tightly

Fig 5: Mouth opened

Fig 6: Screwing Nose

Fig 7: Patient's Diseases Level

Table 6. Comparison of existing & proposed technique

DESCRIPTION	EXISTING METHOD	PROPOSED METHOD
Eye brow rise	86.1%	86.5%
Eye brow closed tightly	73.9%	78%
Screwing nose	83.6%	84%
Mouth opened	92.1%	93%
Average Level	83.9	85.38%

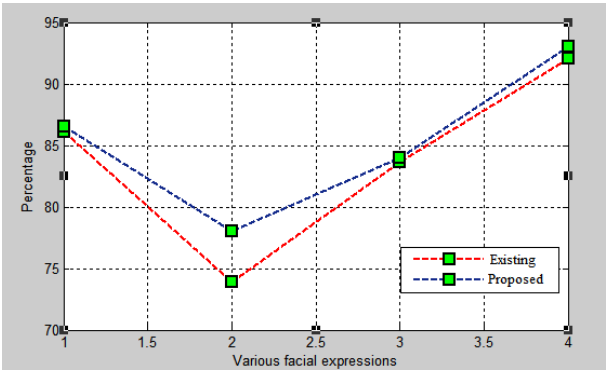

Fig 8: Comparison Plot

4. CONCLUSION

The paralysis makes a critical position to the human. The mouth was a first affected human part in the face and similarly other parts face like Eyebrow, Infraorbital and Screwing nose. By using the mouth edge position and Lateral Canthus, the disease level was predicted. The image data base was prepared by using human at normal condition and the same human at different facial expressions. The proposed method exactly works for the collected images. The proposed method used the IECM algorithm, which accurately finds disease level in the face. The proposed technique uses the 4 different facial expressions. In future more no. of expressions are added in the proposed technique, to achieve more accuracy.

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