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A Comparative Study of Emotion Recognition from Facial Expression

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ABSTRACT: In Image processing, it becomes very interesting to recognize the human gesture for general life. Facial expressions analysis plays a significant role for human computer interaction. In this paper both genetic and data mining algorithm is given. In data mining algorithm the focus is given on facial expression regions such as eyebrow, eye and mouth. Then facial characteristics points are calculated which are given as a input to decision tree which gives output as emotion. In genetic algorithm, preprocessing is applied on input image. Features are extracted and optimized values are calculated. Thus emotions are classified using neural networks.

KEYWORDS: preprocessing, feature extraction, genetic algorithm, neural network algorithm, template matching, classification, data mining algorithm.

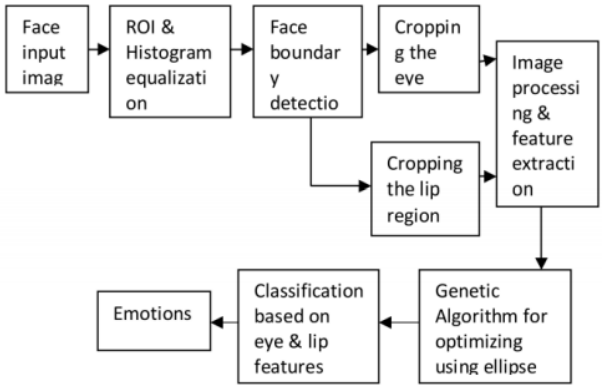
I. INTRODUCTION

Image processing is any form of signal processing for which the input is either photograph, video or frame and output is the set of parameters. There are many ways that humans can express their emotions. Facial expression is the most natural way to express emotion.

Recognition of facial expressions is used to identify the basic human emotions. Recognition system is classified into three parts. First step is based on preprocessing. In preprocessing filtering, ROI, histogram-equalization, edge detection are applied on input face image. Secondly eye, eyebrow and lip features have taken from processed input image. In third stage optimized parameters such as eye, eyebrow and lip are calculated through the Genetic algorithm and then emotions (neutral, happy, sad, surprise) are classified using artificial neural network and GINI index approach. The final calculated result shows that the genetic algorithm gives better performance along with neural network. In section I, introduction is given in detail. In section II, methodology of emotion recognition process using Genetic algorithm is given .In section III, emotion Recognition using data mining algorithm is given. Conclusion is provided in section IV.

II. METHODOLOGY

1. Emotion recognition process is given below.



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A. Preprocessing
In preprocessing, first take input face image and apply filtering on input image. Convert given image into gray scale image and detect face from that image. Find ROI and performed edge detection on face input image. Then the regions are cropped.

B. Edge detection
For face boundary detection, first convert RBG image in to binary image. This binary image is used to detect the forehead. Then the face is cut from the starting position of the forehead. Finally sobel edge detector is applied to the eye, eyebrow and lip image. The sobel edge detected images are given below.


Edge detection of eyes using sobel


Edge detection of lip using sobel

C. Cropping the eye and lip region
For cropping the eye region, consider that w is the width of image and h is height of image. Crop the eye and lip regions and then cut the RGB image according to the size of box.

D. Feature Extraction
In image processing, feature extraction is a special form of dimensional reduction in which input data is transformed into set of features. Y-coordinate of the eye is calculated by using horizontal projection. Then the area around the Y-coordinate is proposed to identify exact region of features. A corner point detection algorithm is used to obtain the required corner points from feature regions.

E. Emotion recognition using Genetic Algorithm
Genetic Algorithm is an iterative process and each iteration is called generation. In each generation, the fitness of each individual is calculated to form new population. In this paper, genetic algorithm is used to calculate the optimised value of eye, eyebrow and lip features. The genetic algorithm is as follows.
1) Represent chromosomes and initial population
2) By using fitness function calculate fitness of each chromosome
3) Select a pair of high fitness chromosome
4) Create new pair of offspring by applying crossover and mutation operators. Then place it in new population
5) Until size of new population becomes size of initial population repeat from step 3
6) Replace initial population with new population

F. Fitness Function:
A fitness function is the type of objective function and it gives optimality of a solution. Fitness function is used to obtain eye and lip features.

G. Emotion Classification using Neural Network
An artificial neural network is a non- linear network. It works like a human brain. Generally, the stage in the neural network is known as training stage. In training stage, adjustment of weights is done. The ANN is used for database in which optimized values are used as an input to train the network. These inputs are trained using back propagation training algorithm.

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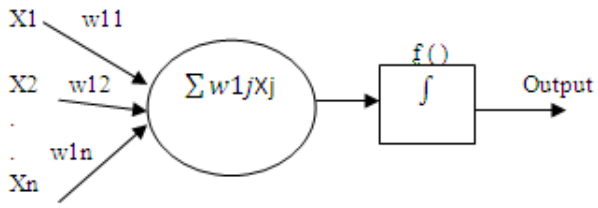

III. EMOTION RECOGNITION USING DATA MINING ALGORITHM

A. Feature Extraction using Template Matching

Template matching is being carried out by making use of convolution and co-relation coefficients for the highest and perfect matching. The eye, eyebrow and lip template are being extracted from the image and then extracted results are shown in the form of bounded rectangles. The data mining algorithm is given below

1) Convert the given input image into gray scale
2) Calculate 2-d convolution
3) find out mean and variance and co-relation score 'C'
4) Find the pixel value of the region whose co-relation score is highest
5) By matching the co-relation score, draw the bounding rectangles accordingly

B. Extracting the Facial Characteristic Points

The bounding rectangles are formed around the matched template which is used to deduce the value of top-left corner pixel from the rectangles. By using width and height of the template , 30 FCP's are computed. Thus the facial animation parameters are calculated from the obtained pixel values. These parameters are represented as opening of eye, width of eye, height of eyebrow, opening of lip, and width of lip.

C. Computation of Facial Animation Parameter

From the FCP's facial animation parameters are calculated.
Openness of eyes:
((fc7_y - fc5_y) + (fc8_y - fc6_y))/2
Width of eyes:
((fc1_x - fc3_x) + (fc4_x - fc2_x))/2
Height of eyebrows:
((fc19_y - fc1_y) + (fc20_y - fc2_y))/2
Opening of lip: (fc26_y - fc25_y)
Width of lip: (fc24_y - fc23_y)
Where, fc1_x, fc2_x, fc3_x, fc4_x, fc7_y, fc5_y, fc8_y, fc6_y, are the x, y coordinate position of the FCP's detected around the eye template. Similarly the FCP's fc1_y, fc2_y, fc19_y, fc20_y are the x, y coordinate position detected around the eyebrow template. FCP's fc23_y, fc24_y, fc25_y and fc26_y are the y coordinates of template. These facial parameters can be used to detect the class label of face data

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D.GINI Index Classification technique

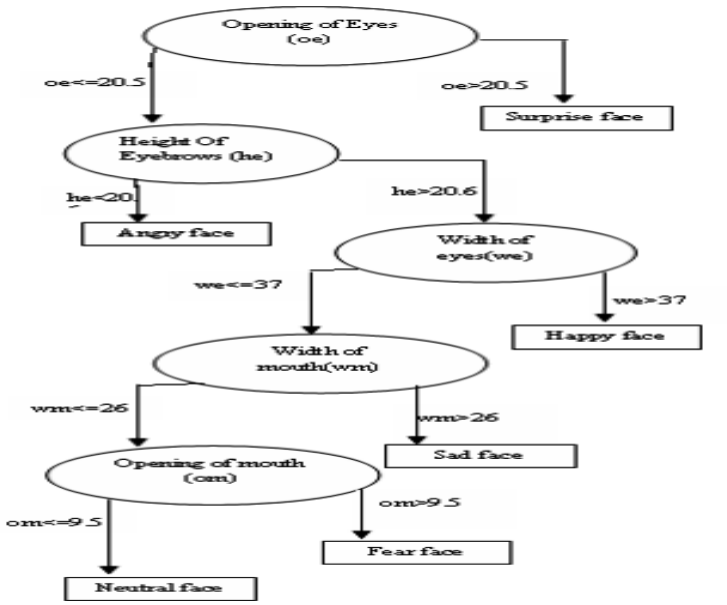

Fig: Decision tree using GINI Index.

GINI index approach is a classification technique. In this technique, each leaf node is represented as a class label. The splitting of data set is performed based on the basis of degree of impurity of the child nodes.

IV. CONCLUSION

In this paper, we studied the data mining for its statistical approach and genetic optimisation algorithm. Genetic algorithm gives optimised value of eye, eyebrow and lip feature. Then this gives input to the neural network and we get emotions. Data mining algorithm evaluates facial animation parameter and these parameters are applied to the decision tree which gives output as emotions. Thus the Genetic algorithm gives the better result than the data mining algorithm.

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