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Human Emotion Identification Using Feed Forward Neural Network with Backpropagation and Bayesian Regularized Backpropagation Algorithm

Sofia R, Sivakumar D

Abstract— ***In this work, initially the human face will be detected. Then the facial features will be extracted and classified into different expressions. Here two types of algorithm viz. used in Feed Forward neural network(FFNN), ie., Backpropagation(BP) Algorithm and Bayesian Regularization Algorithm. After evaluating Bayesian regularized Backpropagation Algorithm (BR) is found to be better suited for automatic facial expression recognition than Backpropagation algorithm(BP), and the performance is evaluate using various metrics.***

Keywords— Backpropagation, Bayesian regularization, Feed forward neural network, Facial expression recognition, Feature extraction

I. INTRODUCTION

The major steps involved in Emotion detection through face is:

1. Face detection
2. Facial feature location
3. Facial feature extraction
4. classification

All these steps involve various procedures, and this work the major process is facial feature extraction and classification. Some of the literature papers relating to the existing work is explained below:

In the method proposed by S.Kherchaoui et al (2014)[1] uses Support Vector Machine classifier (SVM) to predict the facial emotion and they make use of JAFFE database. Yi et al., (2010)[2] proposes the system which combines LBP and Gabor features, for facial expression detection. Premanand et al., (2016)[3] have used Local Directional Number Pattern(LDNP) for extracting features and for classification they use both SVM and FFNN .Debasmita et al., (2013)[4] uses Eigenspaces for finding six expressions- anger, disgust, fear, happy, sad or surprise. Kiran Talele et al., (2016)[5] uses LBP for feature extraction and artificial neural network(ANN) for classification. Kunika and Ajay (2017)[6] uses the Viola Jones method for face detection and the facial features are extracted using Gabor filter and the ANN for classification.

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* Correspondence Author
R.Sofia*. Department of Electronics and Instrumentation Annamalai University,
Dr.D. Sivakumar Department of Electronics and Instrumentation Engineering, Annamalai University,

PROCESSING STEPS

A. *Determination of Input-Target Pair for Training*

1. Assuming n be the no. of images in each set of facial expression
2. Assuming m be the no. of facial expressions
3. Initializing i =1
4. Initializing j=1
5. jth image for Expression(i) is given as input
6. Enhancing the image
7. Extracting the features from the face (eyebrows, eyes and lips)
8. Determine the following values for extracted eyes, eyebrows and lips
   - Orientation
   - MajorAxisLength
   - Centroid(X and Y axis)
   - Area
   - Perimeter
   - Major Axis Length
   - Minor Axis Length
9. Incrementing j
10. If j<n Repeat steps 5-10
11. Converting the calculated values into vectors and assign the target value as (i) for all the vectors.
12. If i<m Repeat steps 4-12

B. *Training the Neural Network*

1. Initializing no. of layers
2. Initializing no. of hidden neurons
3. Set the activation function for each layer
4. Training the neural network with input-target pairs

C. *Testing the Neural Network*

1. Input the test input to trained neural network
2. Obtain the output. From the output values, determine the facial expression.

II. FEATURE EXTRACTION

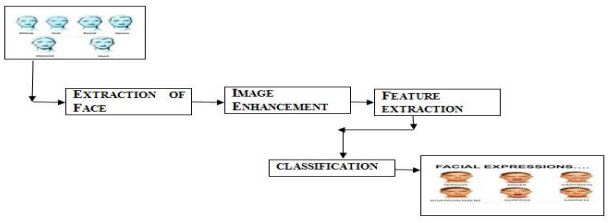

Figure1. Processing Steps

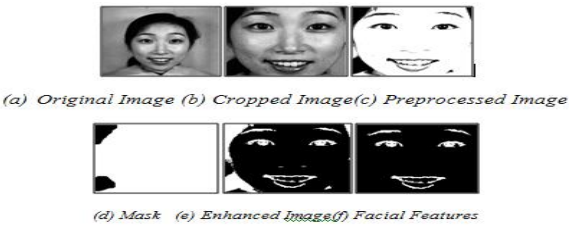

Figure 2 Output for Feature extraction

Front view of the face is taken from JAFFE database and by doing Image processing steps such as cropping, contrast adjustment, gamma correction and masking and doing AND operation the features are extracted.

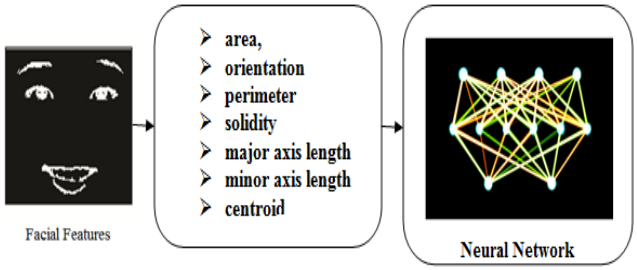

Figure 3 Processing Steps

And extracted features are measured with region properties as shown in figure 3, and those region properties are given to Feedforward Neural Network for training and testing and the performance of the network is shown below.

III. PERFORMANCE EVALUATION

A. *Confusion Matrix*

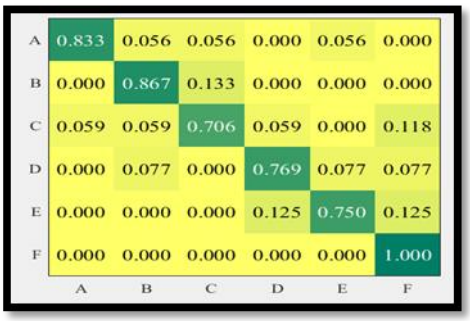

Figure 5

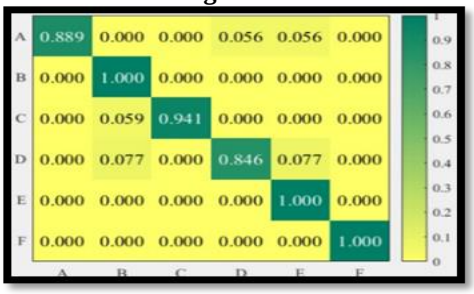

Figure 6

Figure 5 and 6 Confusion Matrix for FFNN with BP and BR algorithm

A- Happy; B- Sad; C- Anger; D-Neutral; E-Disgust; F- Fear
Only Fear has identified properly when using FFNN-BP algorithm and FFNN-BR could identify Disgust and Fear.

B. *Regression Plot*

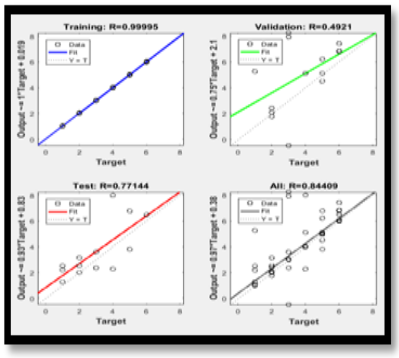

Figure 7

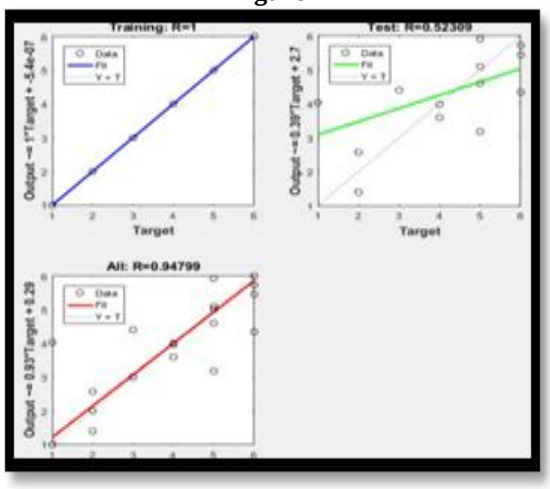

Figure 8

Figure 7 and 8 Regression Plot for FFNN with BP and BR algorithm

Here the R value using FFNN-BR algorithm works good in identifying the emotion with the value nearly equal to 1.

C. *Error plot*

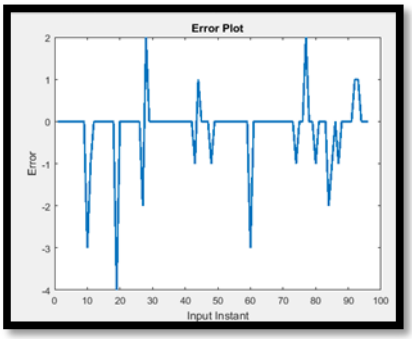

Figure 9

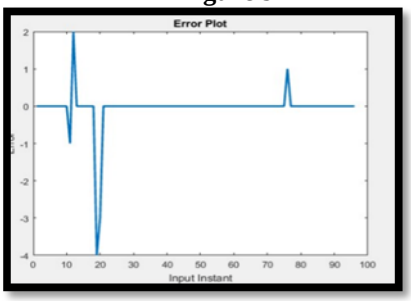

Figure 10

Figure 9 and 10. Error Plot

Here the Error plot for FFNN-BR shows the almost horizontal line which indicates the betterment in network performance when compared to FFNN-BP algorithm

D. Mean Absolute Error (MAE)

For FFNN-BP algorithm shows the MAE value as 29.17% and FFNN-BR algorithm shows the MAE value as 15.83%..

IV. CONCLUSION

The feed forward network uses two types of algorithm viz., Backpropagation algorithm and Bayesian regularization algorithm. And the result is shown by comparing the performance evaluation plots i.e., Error histogram, Regression Plot, Error Plot, Confusion Matrix and also by calculating the Mean Absolute Error. And the results shows that Bayesian regularized Backpropagation algorithm shows the better result compared to Backpropagation algorithm with the mean absolute error of 15.83%, and the Backpropagation algorithm gives the MAE value of 29.17%, which in turn proves the BR algorithm is efficient than the BP algorithm in identification of emotions.

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AUTHORS PROFILE

R.Sofia. Ph.D Research Scholar, Department of Electronics and Instrumentation Annamalai University, Area of Interest is Image processing, Signal Processing, Digital Communication.

Dr.D. Sivakumar, Professor, Department of Electronics and Instrumentation Engineering, Annamalai University, he has nearly 40 years of experience in field of Teaching and his area of interest is Control system, Process, Digital signal Processing Image processing.