Emotion Detection Using Neural Network for Images

Prof. Snehal P. Gaikwad, Dr. Leena R. Ragha

Abstract— In recent developments, emotions/feelings play a major roll in understanding human psychological behaviour. There are applications which carry the tasks based on emotion detection. All human beings, pets, and even trees have emotion. Facial expression (FE) is a result of one or more motions or position of muscles beneath the skin of the face and is a primary means of coveying social information between humans. Eyes, eyebrows, nose, and mouth are often viewed as important features of FE. We propose to detect FE (emotion) from still pictures of the human face. Face image is processed by extacting fudicial points using geometrical method. Gabor filter is applied around the points to extract the features. We also extracted features by Local Binary Pattern (LBP) from the whole image. This combination of featues is applied to Principle Component Analysis (PCA) to reduce dimensionality and finally normalized features are given to Multilayer Perceptron (MLP) classifier to detect one emotion out of seven possible emotions considered in our experiments. As features are extracted around the fuducial points to extract strong features.We expect that, emotions like angry, disgust, fear, happy, neutral, sad, surprise can be detected.

Index Terms— FE – Facial Expression, FER – Facial Expression Recognition, GW – Gabor Wavelet, JAFFE – Japanese Female Facial Expression, LBP – Local Binary Pattern, MLP – Multilayer Perceptron, NN – Neural Network, PCA – Principle Component Analysis.

1 INTRODUCTION

Emotion, often called as feeling. All human beings and even pets have more emotions or feeling. When human being sees suddenly something happening around him/her some expression is observed on face. This feeling is nothing but emotion. Genrally FE is of following part
Subjective response: It means that every person have his own way to express his emotion, so no two people can express their feelings in same manner. Expressive behavior: This is nothing but express feeling by outward sign, thatincludes tone of voice, breathing, face reaction, or body language.
Emotions are nothing but combination of physiological and physical reaction to particular event. Physiological symptoms arelike when person is angry or he is in fear his heart beats are increases; sometimes temperature of body may increase or decrease. The unit of brain is called as neurons [6]. The face images are taken and facial points (fiducial points) are considered
Suppose if person become angry his nose, lops, eyes are out of neutral expression so that it can be found that person express which emotions on these changes. So detect the particular emotion

2 PREVIOUS ANALYSIS (PA)

Table 1 mention previous analysis details and Figure 1 shows five flow diagrams which give detail explanation of all PA's. From the flow diagram PA1 gives better result for fear expression it also gives good result for other expression, PA2 gives highest result and accurate result as it is combination of geometric and GW method. In our proposed method two methods are used i.e. GW and LBP respectively. LBP is used in PA3. PV4 uses Eigen faces but this method is very sensitive to head orientation also most mismatches occur for images [5]. MLP is used in PA2, PA5 as it works as best classifier so it is used in proposed method.

TABLE 1
PRIVIOUS ANALYSIS (PA) DETAILS

Paper no	Input/Output	Feature Extraction	Recognition	Result & Analysis
9	JAFFE	GW using graphical method with PCA	LVQ network	LVQ is better than MLP and gives good result for fear expression. Result is 87.51%
8	JAFFE	Geometric method, Multioriented Gabor wavelet coefficient with PCA	MLP network	Combination of geometric and GW gives 92.3% result and better then previous method.
13	The Geneva Emotion Research Group GEMEP	LBP with PCA	Support Vector machine (SVM)	Action Unit (AU) is detected expression SVM. Accuracy is 88.8%
14	(ORL) face database	Eigen face method with PCA	K-means, Fuzzy Ant with fuzzy C-mean	Output is with 86.75%
15	Cohn Kanade AU code FE dataset image	Extract features from 3 reactangle as AU	MLP 3 layer network	Output is 93%

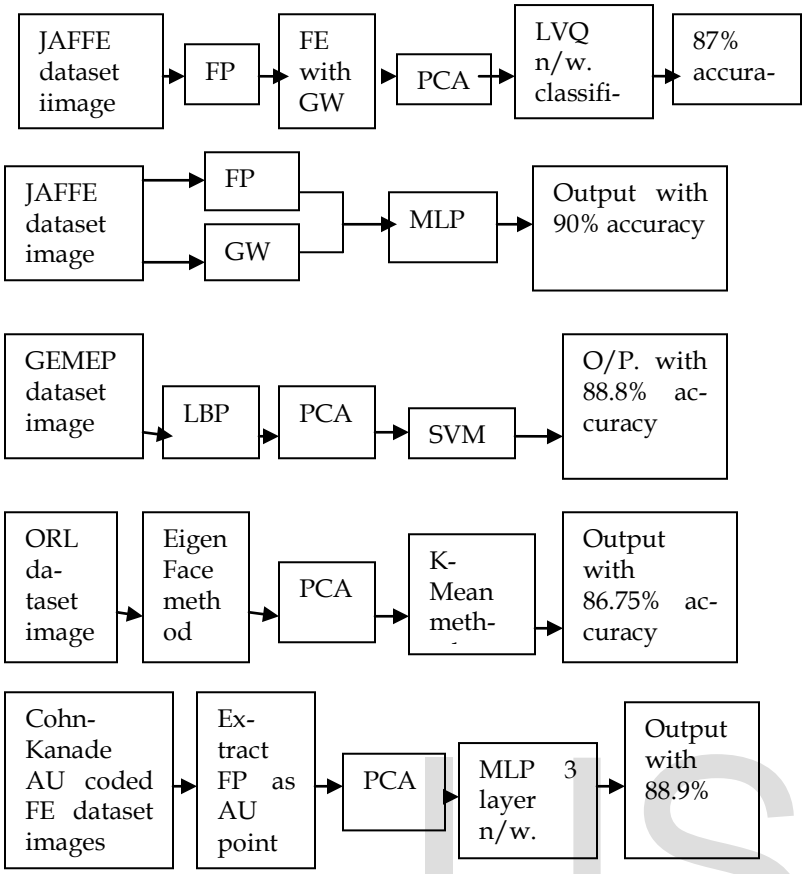

Figure 1 Flow Diagram of PA1, PA2, PA3, PA4, and PA5.

3 POPOSED SYSTEM AND TECHNICAL EXPLATION

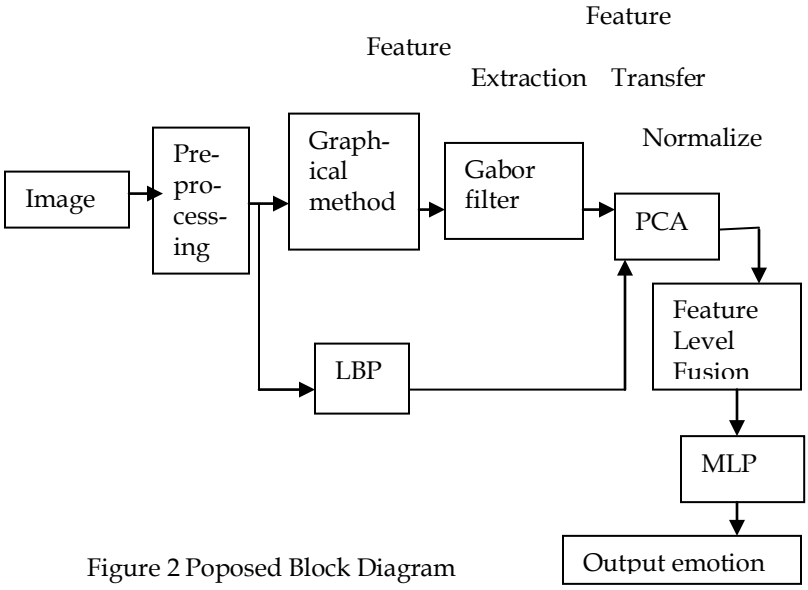

Figure 2 Poposed Block Diagram

Block diagram of proposed method is as shown in figure 2. The image is gray scale image taken from JAFFE database. The database contains 213 images out of that 70 images are used.

Ten JAFFE images are as shown in figure 4. In prepro-cessing image will be resized to 256×256 and Median filtering is applied to remove noise.

Figure 3 JAFFE database details [8], [9].

Among several findings in image processing and comression research, FE for face recognition and tracking using Gabo filter banks is reported to yield good results [3]. Therefore, Gabor filter bases FE technique is promising FE technique for FER. A discrete set of Gabor kernals is used that comprises of 3 spatial frequencies (with wavenumber k π/4, π/8, π/16) and 6 distinct orientations from 0^0 to 180^0 differing in 30^0 steps that makes a filter bank of altogether 18 different Gabor filter [4], [5]. These Gabor filters are applied to each of the images and filter responses are obtained only at predefined fiducial points. These points are extracted from image by graphical method. Grafically we point out main fiducial points manually on each image. Fiducial points are nothing but geometric representation of image.

Total 32 fiducial points will be taken. It means that 32 points are set at particular area from where we can recognize expression. Fiducial points are those which are used to extract particular information (feature) from images. Set fiducial points as shown in figure 4.

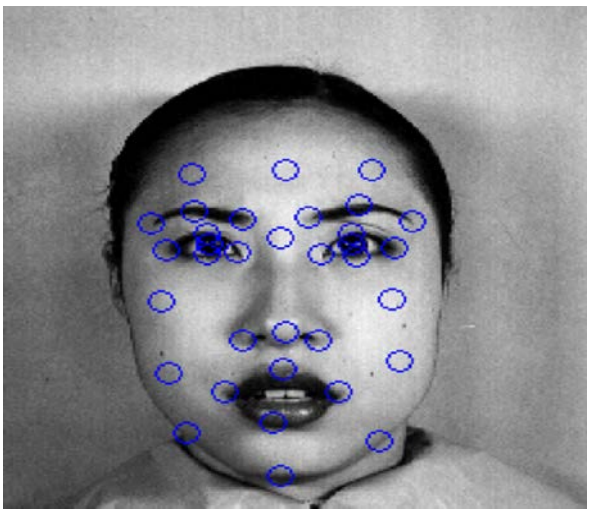

Figure 4 Location of fiducial points.

Gabor filter bank is used to obtain feature vector at these 32 points only. By this we will get features at these points. Gabor filter is directly related to GW, since they can be designed for number of dilations and rotations. However, in genral expansion is not applied for GW, since this requires computation of

bi-orthogonal wavelets, which may be very time-consuming. Therefore, usually a filter bank consists of Gabor filter with various scales and rotations are created. Here 18 bifferent Gabor features as shown in figure 5. Some of the features looks to be similar but small variation is amplitude as well as rotation is present.

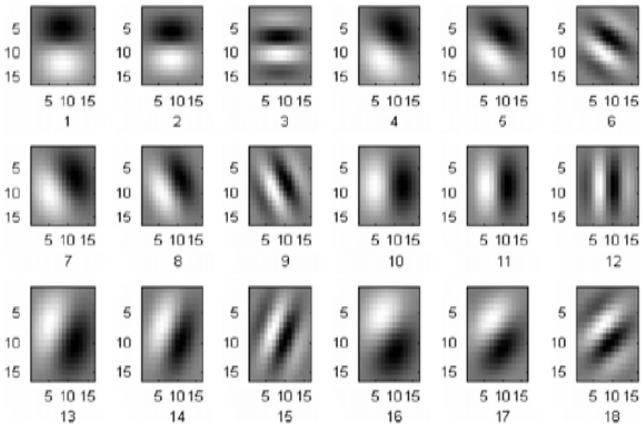

Figure 5 Gabor features

Apply Gabor filter bank to obtain the feature vector at these 32 points.Gabor filters are directly related to GW, since they can be designed for a number of dilations and rotations. Featues (fiducial points) are selected by graphical method extracted by Gabor filter.

$\Psi(k, x) = k^2/\sigma^2 \exp(-k^2x^2/2\sigma^2)[\exp(ik.x) - \exp(\exp(-\sigma^2/2))]$ (1)
Where,
K = wave vector,
x = orientation angle 0^0 to 180^0 differing 30^0, 60^0, 90^0, 120^0, 150^0, 180^0 changes to get good orientation.
σ = relative width
Set σ = π for 256×256 image.

This equation (1) is used for featue extraction for Gabor filter.
A 2-D Gabor function is a plane wave with wave-factor k, restricted by Gaussian envelope function with relative width σ. A discrete set of Gabor kernals is used that comprises of 3 spatial frequencies 6 distinct orientations that make a filter altogether 18 different Gabor filters.

The LBP operator is an image opeator which transforms an image of integer labels describing small-scale appearance of the image. These labels or their statistics, most commonly the histogram, are then used for further image analysis. The extracted feature histogram represents the local texture and global shape of face images.

$Hi, j = \Sigma_{x,y}\{f_i(x, y) = I\}\, I\{(x, y) \in R_J\}$ (2)
Where, i = 0… n-1, j = 0 … m-1

Figure 6 shows reactangular approach for LBP. LBP operator takes the form as mention in figure 7 and figure 8 shows LBP operation. Then LBP is used for feature extraction. LBP operator is used as means of summarizing local gray-level structure. The operator takes a local neighborhood around each pixel, thresholds the pixels of the neighborhood at the value of the central pixel and uses the resulting binary-valued image patch as local descriptor. It was originally defined for 3×3 neighborhoods, giving 8 bit codes based on the 8 pixels around the centeral one.

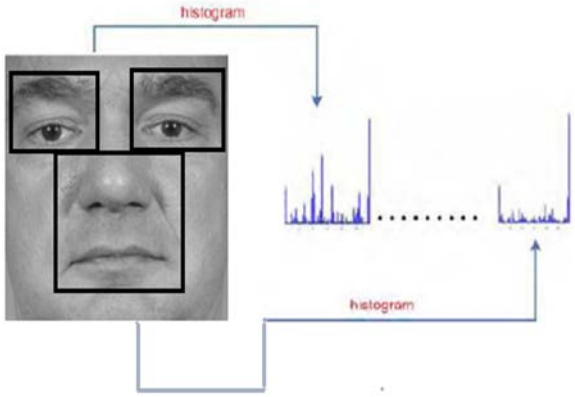

Figure 6 Rectangular approaches for LBP.

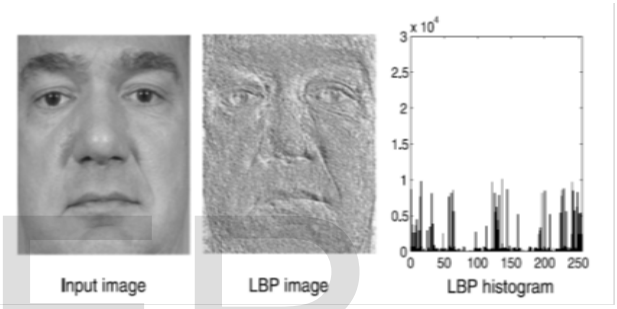

Figure 7 LBP process for face image.

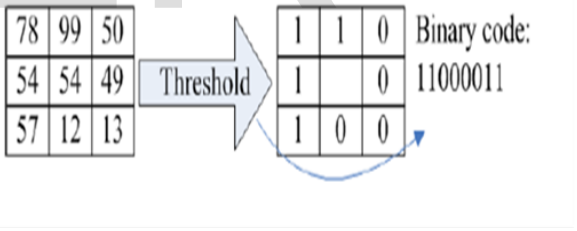

Figure 8 LBP operations.

The output of Gabor filter is large. The size can and be reduced by using PCA. This is feature vector of the same image. Unlike other linear transforms, PCA does not have a fixed set of basis vectors and its basis vectors depend on the data set. In this study matlab inbuilt function prepca has been used to reduce dimensionality of the feature vector.

Feature level fusion is used since two different feature vectors of same input image so consider them as a final vector for these purpose feature vectors should be fused. This technique is known as feature level fusion. This fused vector is called as z-score since it is the final value of two different feature vectors and it is obtained by normalization technique based on standerd deviation.

$$Z = (y_1/\sigma_1, y_2/\sigma_2)^T \quad (3)$$

Where, σ_1, σ_2 are (scalar) standard deviations of y_1, y_2.
The fusio output is applied to NN classifier i.e. MLP classifier displays 7 classes (FE). The output values are between 1 and 0.

The maximum value is matched emotion. The MLP consists of three or more layer (an input layer, output layer with one or more hidden layers) of nonlinearly activating nodes. Thus output from MLP classifier which classifies emotions in different classes and from that out emotion is recognized.

4 Conclusion

We take particular points (fiducial points) from face by using graphical method we poduce points for extraction. We use two different feature extractions LBP and GW. Output from these both methods are applied on fusion method (cobiner) to get single feature vector. By combining two metthods we get best result which is best then the previous work done in this area. PCA is applied on this output output to lower the dimensionality. Finally classify this this output by MLP classifier. The output values are between 1 and 0. The maximum value is the matched emotion. After classification we recognize one out seven different emotions as an output. Emotions like anger, disgust, fear, happy, neutral, sad, and, surprise.Thus we perform FER using different extractor methods successfully.

References

[1] G. Donato, M.S. Bartlett, J.C. Hager, P. Ekman, T.J. Sejnowski, "Classifying Facial Actions", IEEE Trans. Pattern Analysis and Machine Intelligence, Vol. 21, No.10, pp. 974-989, 1999.

[2] P. Ekman and W. Friesen," Unmasking the Face: A guide to recognizing emotions from facial expressions".Consulting Psychologists Press, Palo Alto, CA, 1975.

[3] K.-K. Sung and T. Poggio,"Example-based learning for view-based human faces detection". Technical Report A.I. Memo 1521, CBCL Paper 112, MIT, Dec. 1994.

[4] H. Rowley, S. Baluja, and T. Kanade," Human face detection in visual scenes" Technical Report CMU-CS-95-158R, School of Computer Science, Carnegie Mellon University, Nov. 1995.

[5] Sun, Z., Yuan, X., Bebis, G., Louis, S.J.," Neural-network-based gender classification using genetic search for eigen-feature selection". In: Proceedings of the IEEE International Joint Conference on Neural Networks 2002.

[6] Lawrence, S., Giles, C., Tsoi, A., Back, A.," Face recognition: a hybrid neural network approach". Technical Report UMI-ACS-TR-96- 16, University of Maryland 1996.

[7] De Stefano, C., Sansone, C., Vento, M.," Comparing generalization and recognition capability of learning vector quantization and multilayer perceptron architectures. In: Proceedings of the 9th Scandinavian Conference on Image Analysis, June, pp. 1123–1130, 1995.

[8] Zhang, Z., Lyons, M., Schuster, M., Akamatsu, S., "Comparison between geometry-based and Gabor wavelets-based facial expression recognition using multi-layer perceptron" In: Proceedings of the Third IEEE International Conference on Automatic Face and Gesture Recognition 1998.

[9] Shishir Bashyal, Ganesh K. Venayagmoorthy," Recognition of facial expressions using Gabor wavelets and learning vector quantization", Department of Electrical and Computer Engg. & Technology, MO 65409, USA,12 Nov. 2007.

[10] Lyons, M., Akamatsu, S., Kamachi, M., Gabor, J.,"Coding facial expressions with Gabor wavelets". In: Proceedings of the Third IEEE International Conference on Automatic Face and Gesture Recognition 1998.

[11] Bartlett, M. S., Hager, J. C., Ekman, P., Sejnowski, T. J.," Measuring facial expressions by computer image analysis". Psychophysiology 36, 253–26, 1999.

[12] Chellappa, R., Wilson, C.L., Sirohey, S.," Human and machine recognition of faces: a survey" IEEE Proceedings 83, 705–740, 1995.

[13] Michel F. Valstar, Bihan Jiang, Marc Mehu, Maja Pantic, and Klaus Scherer, "The First Expression Recognition and Analysis Challenge"

[14] Mayank Agarwal, Nikunj Jain, Mr. Manish Kumar and Himanshu Agrawal, "Face Recognition Using Eigen Faces and Artifical Neural Network" , International Journal of Computer Theory and Engineering, Vol. 2, No. 4, August, 2010 1793-8201.

[15] MU-CHUN SU, YI-JWU HSIEH, AND DE-YUAN HUANG, "A Simple Appoach to Facial Expression Recognition", Proceeding of the 2007 WSEAS International Conference on Compute Engineeing and Applications, Gold Coast, Australia, January 17-19, 2007.