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Facial Emotion Recognition and Classification Using Hybridization Method

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ABSTRACT—Recognition of emotions in facial expressions has become a famous technique in 21st century. In this paper the facial emotion recognition will be done using the hybridization of neural network with ICA as well as genetic algorithm. Firstly the feature extraction will be done using ICA then the feature reduction will be done using genetic algorithm in which features are reduced to small dataset. Then classification of five emotions will be done like SAD, HAPPY, SURPRISE ANGRY and NEUTRAL using neural network classifiers. The whole simulation has been taken place in MATLAB environment. The result value obtained by this approach is good and efficient and requires less effort of extracting different features individually.

KEYWORDS—Face recognition, Emotions, Feature Extraction, Classification, Genetic Algorithm, Neural Network, ICA

INTRODUCTION

Human beings express different emotions according to the activities performed in routine. Emotions play a vital role and often reflected on the face. Recent research has shown that most expressive way of showing emotions is via face expressions.

The importance of facial expression system is widely recognized in social interaction and social intellect. Since 19th century, the system analysis has been dynamic [18] research subject matter. In 1978, the facial expression acknowledgement system was presented by Suwa et. al. The foremost problem that occurs in constructing a facial expression recognition system is detecting face, normalizing image, extracting features, and cataloging. There are several number of methods which we can use for recognizing the facial expression. Some of the researchers [1] introduced the system can recognize the different human gesture in color image.

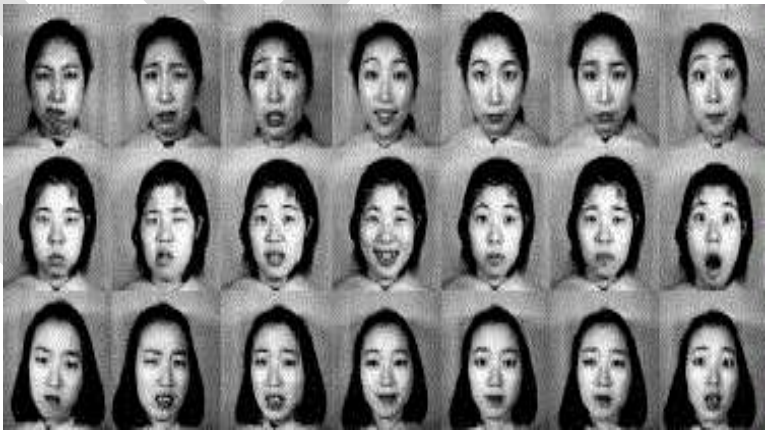

Figure.1 Japanese Facial emotion Samples

LITERATURE SURVEY

In this paper, the face detection technique using neural network classifier is being used. Afterwards carrying out the preprocessing operation then in next operation of recognition is executed, the straightforwardness and resilient of the system is noteworthy. Be contingent on threshold value the investigators system can identify the facial expression. The approach of this system can be adapted to real time and it briefly describes the schemes of capturing the image and to recognize the gestures. In the field of neural network, back propagation method mostly used for recognizing the facial expression [2].

The paper proposes the different techniques to extract the features such as mouth, cheek, mid forehead, and forehead. These separated characteristics offers different recognized output using back propagation technique which show that the back propagation algorithm can identify the suitable facial expression as compared to other techniques. These networks are being extensively used and also the work is deliberated as a focal part of artificial neural network. The efficient algorithm for motion detection based facial expression recognition is an optical flow algorithm that helps in facial motion detection. This method is established on optical flow method which abstracts the obligatory motion vectors. Optical flow reflects the image changes due to motion during the interval of time. This algorithm works on frames of segmented image and gives us their result which is depending on motion vectors. The strongest degree of similarity determines the facial feelings. The procedure test the work has been done on the basis of Action units (AU) coded facial impression database. Using this method, in which through matching of the system can diagnose the facial expression. There are four types to identify that expression. The first kind of this uses emotion space to identify facial impression. The second category is to identify facial expression of a picture frame through using optical flow. The third kind is to use some of the dynamic shape models to identify facial expression. The fourth kind is used to identify the facial expression via using neural network [3].

The paper proposes a system that demonstrates an automated facial expression recognition system using neural network [4]. Facial expression recognition provides an important behavior for the detailed research of emotion or feelings. Now this paper, the neural network models define the mechanized facial expression recognition method with hybridization of ICA and Genetic procedure. The researcher presented a new method that is the point counter detection method; through using this method the system can extract the features from individuals face. The face is a multifarious multidimensional visual model and it is used for developing a model for face recognition is difficult job.

Repeated recognition of facial terminology is a significant [5] part for human machine interface. It has lot of magnetism in research area since 1990's.Though humans distinguish face without attempt or delay; gratitude by a machine is still a face. Some of its challenge is highly dynamic like orientation of face, lightening effects, scale of face, facial expression and occlusion in the image. Applications are being used in the fields like verification of user, detection of person, observation of any video, information security purposed, isolation of data etc. A mixture of approach for facial recognition is categorized into two ways- explicitly holistic based facial recognition and quality based facial recognition.

Facial terminologies give significant result in order about emotions of a human being. Sympathetic facial expressions accurately are one of the taxing tasks for interpersonal relationships. Regular emotion discovery using facial expressions appreciation is now a main area of notice within various fields such as computer science, medicine, and psychology. HCI research community also use computerized facial expression appreciation system for better consequences. Different feature extraction techniques have been developed for appreciation of terms from static images as well as real time videos [6].

An organization of facial talking is a great face in the area of computer mental picture. Using single characteristic models, the proportion of recognition is significantly low even in prescribed circumstances of capture. To get better the accuracy of the facial feeling acknowledgment and organization, a new method is planned in this document base on the fusion of facial appearance extract from different technique [7].

Facial Expression Recognition is actually a speedily rising and an ever green investigation field in the area of Computer Vision [9], Artificial Intelligence and mechanization. There are variety of applications which use Facial Expression to assess human character, human feelings, finding, and its perspective [8].

In this paper, the different articulations are prepared and put away in the database. In the mid testing process, the picture which is tested is contrasted and the related pictures in the primary database is created as outcome. The preparation and testing methodology in this paper used essential part of PCA for calculations [9].

In this paper, They propose methodological change to raise face acknowledgment rate by melding the stage and greatness of Gabor's representations of the face as another representation, in the spot of the raster picture, despite the fact that the Gabor representations were generally utilized, especially in the calculations in the variety of methodologies, the Gabor stage was never misused, and was trailed by a face acknowledgment calculation, in light of the foremost segment Analysis approach and Support Vector Machine (SVM) is utilized as another classifier for example acknowledgment [10].

This exploration goes for creating "Personality Implemented Robots" that can do scholarly discussion with people. The initial phase in this course is to perceive human feelings by a PC utilizing neural system [11]. This paper investigates a method for human PC cooperation that empower the PC to be more mindful of the client's enthusiastic outflows we introduce a methodology for the feeling acknowledgment from an outward appearance, hand and body carriage [12].

This study researches the vicinity of entrainment at the feeling level in cross-methodology settings and its discussion on multimodal feeling acknowledgment frameworks. The examination investigates the relationship between acoustic highlights of the speaker and outward appearances of the conversationalist amid dyadic associations [13].

The paper mostly concentrates on static 2D face pictures through recreating 3D model by a particular calculation [14].

The proposed calculation is in light of a far reaching examination of the cross-connection properties that portray FAPs, which is here reported and talked about broadly [15].

In this paper they propose a consolidated technique for face identification and distinguishing proof utilizing SIFT descriptors. This consolidated system incorporates a current identification model and another ID technique in light of item class invariants (OCIs), which is invariant to interpretation, scale, in-plane pivot and little 3D perspective changes [16].

This paper introduces another example acknowledgment system for face acknowledgment taking into account the blend of Radon and wavelet changes, which is invariant to varieties in outward appearance, and brightening [17].

In this paper, a summed up structure for demonstrating and perceiving outward appearances on different manifolds is displayed which expect that distinctive articulations may dwell on diverse manifolds of conceivably distinctive dimensionalities [18].

They propose an effective strategy for feeling acknowledgment from outward appearances in static shading pictures containing the frontal perspective of the human face [19].

In this paper, a way to deal with the issue of programmed facial highlight extraction from a still frontal postured picture and characterization and acknowledgment of outward appearance and consequently feeling and temperament of an individual is exhibited [20].

CURRENT PROBLEMS OF FACIAL EXPRESSION SYSTEM

There are three main factors to construct a Facial Expression Recognition system, namely identification of face, extraction of facial features, and cataloging the reactions or feelings.. An ideal emotion analyzer should recognize the subjects irrespective of age, sexual characteristics and any society. The facial expression recognition system should be never changing with respect to the diverse lightening surroundings and disturbance as changes in style of hairs, presence of hairs on face, spectacles, beard, etc. and also should be able to “fill in” missing parts of the face and helps in producing a whole face. It should perform efficient facial expression analysis despite large changes in viewing condition, rigid movement, etc. A good reference system is the human visual system [10]. The current systems are far from ideal and they have a long way to achieve these goals.

METHODOLOGY

In this article the system proposed five stages: face detection, pre-processing, extraction of facial features using Independent component analysis (ICA), optimizing these features using Genetic Algorithm and classification of expression using Neural Network as shown in Figure.

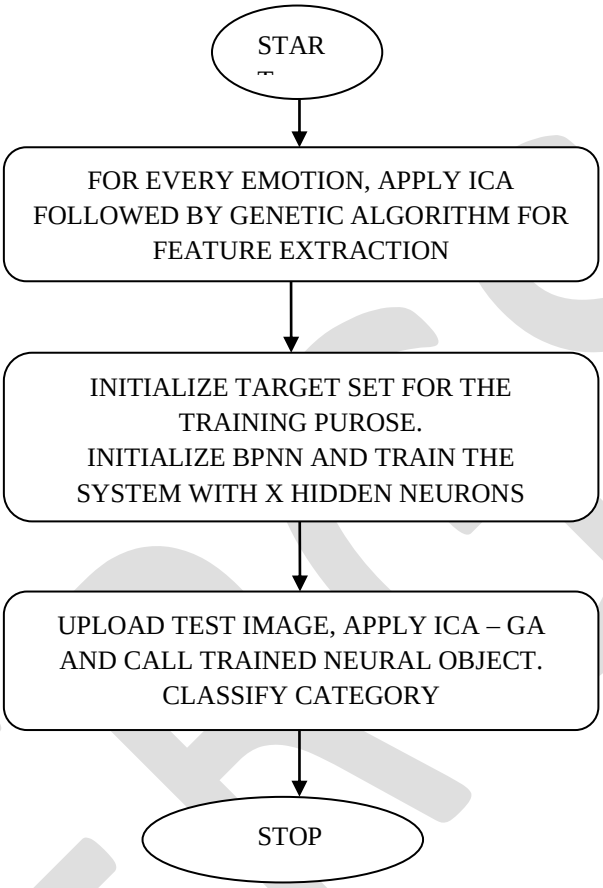

Figure 2: Architecture of Facial Expression Recognition System

The first stage is face recognition method. In this technique the database of pictures are almost indistinguishable environment of distance, background, etc. the collection of all the images includes different poses with different impressions. These are intended for constructing any sort of database of some pictures that are used for training and some for testing, both of which include number of expressions [11].

The proposed technique depends on coding and decoding technique. In the first step, information is obtained, programmed as well as then matched with the given database of model. The next step is the preprocessing module, in this the image gets normalized and it also removes the noise from the picture. In the eigen face library the database picture set is further divides into two sets- training dataset and testing dataset. The Eigen faces are calculated from the training set. These training set pictures are compared through the finest Eigen faces, which also have the biggest Eigenvalues. For computing those particular eigenvalues that are the independent component analysis algorithm (ICA) used [12]. Then feature reduction is done using genetic algorithm (GA). At the last stage of architecture the neural network trained the function in various field of application. The Artificial Neural Network (ANN) can be used for the database in which the face descriptors are used as an input to train the network.

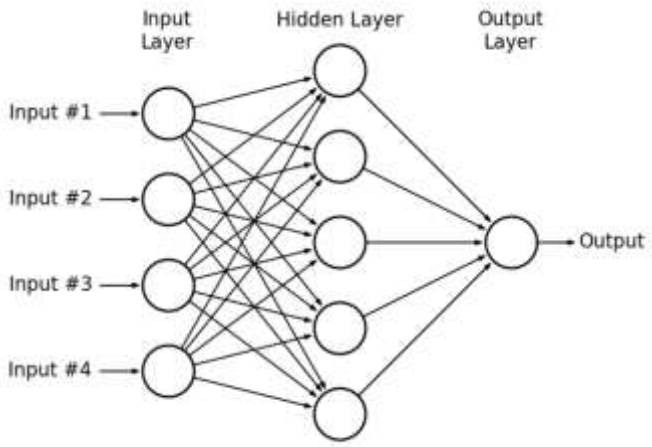

Figure 3: Architecture of feed-forward back propagation neural network

The figure gives an example of feed-forward back propagation neural network, in which the input layer is a collection of neurons [13]. These collections of neurons arrange for the information of forehead, mid forehead, and mouth to the next layer of the neuron collection. Then the following layer is known as a hidden layer which is used to calculate the values and provided to the output layer, where the system provides the different expression [14] as an output. For all positive result the network shows 1 in output and for all negative result 0 is present in output result. If any fresh database is acquired for training then firstly the neural network match all the new result to the pre-built dataset and match the maximum threshold values and provide the output. Then it is confirmed that the new facial expression is belong to the recognized person with the maximum output.

- **GA WORK STRUCTURE**

1. **[Start]** Generate the random population of *n* chromosomes (suitable solutions for the problem)
2. **[Fitness]** Evaluate the fitness function *f(x) for* each chromosome *x* in the population
3. **[New population]** Create a new population by repeating following steps until the new population is complete[15]
4. **[Selection]** Select two parent chromosomes from a population according to their fitness (the better fitness, the bigger chance to be selected)
5. **[Crossover]** This step crossover the parents to form a new offspring (children) with a crossover probability,. If no crossover was performed, offspring is an exact copy of parents.
6. **[Mutation]** With a mutation probability mutate new offspring at each locus (position in chromosome).
7. **[Accepting]** Place new offspring in a new population
8. **[Replace]** Use new generated population for a further run of algorithm[16]
9. **[Test]** If the end condition is satisfied, then **stop**, and it will return the best solution from the current population
10. **[Loop]** Go to step **2**

- **ICA WORKSTRUCTURE**

In the ICA algorithm the data are represented by the random vector $x = (x1\ldots\ldots xm)^{Tm}$ and the components as the random vector $s = (s\ldots\ldots Sn)^{T}$ The task is to transform this observed data x into maximally independent components S using a linear static transformation *W* as S = Wx measured by some function F(S……..S1) of independence [17].

DATABASE

Since the main purpose of this project is facial expression recognition, therefore, the sample pictures must be taken under special consideration so as to ease up the face identification procedure. Each image is captured following the condition that, only face is the largest skin colored continuous object in the frame. There are two sets of images. One of the set is used for training purpose and second one is used for testing purpose. The pictures are classified in the following expressional classes.

- Happy
- Sad
- Surprise
- Angry
- Neutral

Another picture set is used for testing purpose. These pictures are captured in quite a random manner. It also includes some impressions that are not contained in the training set.

The following pictures are some examples for the different classes of expression

HAPPY:

SAD:

SURPRISE:

ANGRY

NEUTRAL

IMPLEMENTATION AND RESULTS

The whole implementation has been taken place in MATLAB environment. Below figure shows the implementation results of the proposed technique.

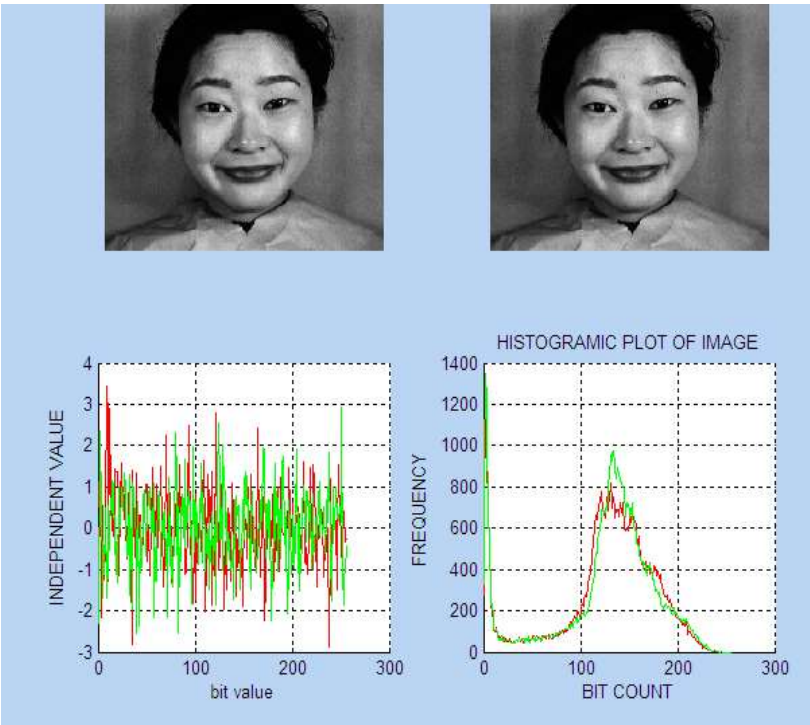

Figure 4: Histogram Plot

The above figure represent the feature extraction process performed while the execution. The figure contains the Independent values extracted by the algorithm and the histogram equalization process. The entire process extracts around 500 independent components which are further optimized using Genetic Algorithm. The population size for Genetic algorithm is total number of features extracted while processing using Independent component analysis. The entire data obtained after applying GA is set to be an input to the neural network and it trains the data in the following manner.

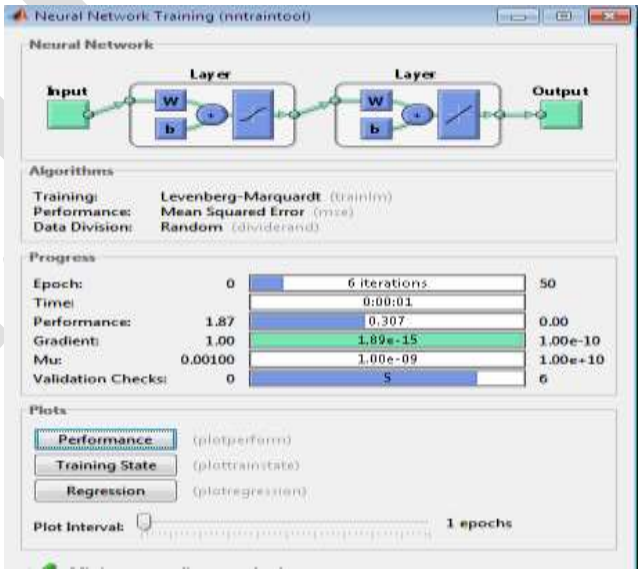

Figure 5: Neural Network Model

The above figure represents the trained Neural Network which has 6 epochs running i.e in 6 epochs the training has been completed and total number of iterations is 50. This indicates that the validation procedure is complete on the 6th iteration only.

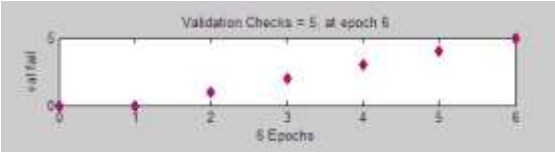

Figure 6: Validation Checks

The above figure shows that at how many epochs, how much validations have been applied. Maximum of 5 validations has been achieved at epoch number 6 hence neural network stops at 6 iterations.

Table: 1 Accuracy Table

CATEGORY	ACCURACY
SAD	98.23
HAPPY	95.63
ANGRY	98.78
SURPRISE	99.21
NEUTRAL	98.65

The above table represents the accuracy of the performed process.

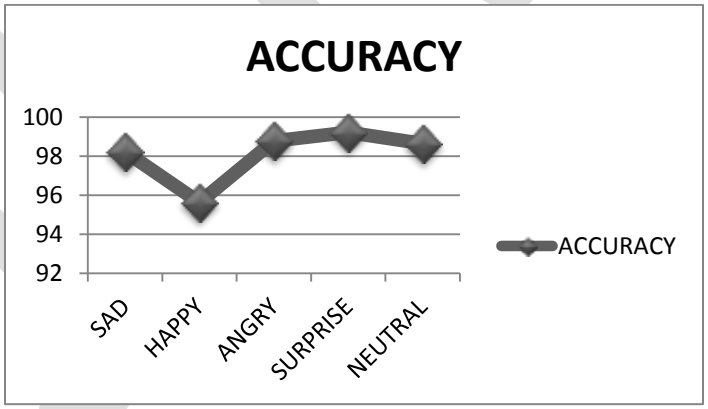

Figure 7: Accuracy Graph

Table 2: FAR and FRR values

CATEGORY	FAR	FRR
SAD	.00882	.00888
HAPPY	.020	.02185
ANGRY	.0056	.0067
SURPRISE	.00391	.00396
NEUTRAL	.00671	.00771

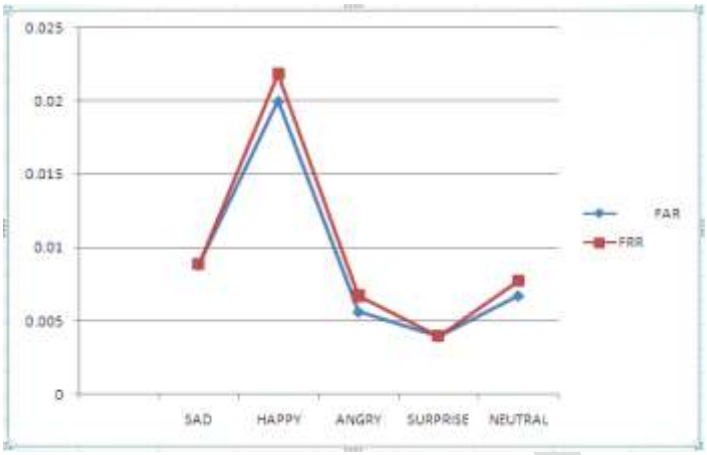

Figure 8: FAR and FRR graph

The above graphs represents the FAR and FRR for the specified accuracy.

CONCLUSION

In this paper the five emotions HAPPY, SAD,SURPRISE, NEUTRAL and ANGRY based on automatic facial expression recognition systems are overviewed. The neural network, Genetic algorithm approach is based on face acknowledgement, classification and feature extraction. The methodology of facial expression identification technique involves the optimization technique, independent component analysis algorithm (ICA) and neural network method. The methodology does make available a real-world clarification to the problem of facial expression recognition and it can work well in constrained environment.

REFERENCES:

[1] J. L. Raheja and U. Kumar "Human Facial Expression Recognition from Detected in Captured Image Using Back Propagation Neural Network" International Journal of Computer Science and Information Technology, February 2010.
[2] Qiuxiawu, Zhiyong Wang, member, IEEE, Feiqi Deng, member, IEEE, Zheru Chi, member, IEEE, and David Dagan Feng, Fellow IEEE 2013 "Realistic human action recognition with multimodal feature selection and fusion" IEEE transactions on systems, man, and cybernetics: systems, VOL.43, NO, 4, July 2013
[3] T. Baltrušaitis, D. McDuff, N. Banda et al "Real-time inference of mental states from facial expressions and upper body gestures" in Proceedings of the IEEE International Conference on Automatic Face and Gesture Recognition and Workshops (FG '11), pp. 909–914, March 2011
[4] G. Littlewort, M. S. Bartlett, L. P. Salamanca, and J. Reilly "Automated measurement of children's facial expressions during problem solving tasks" in Proceedings of the IEEE International Conference on Automatic Face and Gesture Recognition and Workshops (FG '11), pp. 30–35, 2011
[5] Hemalatha, G., and C. P. Sumathi "A Study of Techniques for Facial Detection and Expression Classification" International Journal of Computer Science & Engineering Survey (IJCSES) Vol 5 (2014)
[6] Jyoti Rani et.al," Emotion Detection Using Facial Expressions -A Review" International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 4, April 2014
[7] Ch.VenkataRamiReddy " Multi-Feature Fusion based Facial Expression Classification using DLBP and DCT" International Journal of Software Engineering and Its Applications Vol.8, No.9 (2014), pp.55-68
[8] Lucey, Patrick, et al. "The Extended Cohn-Kanade Dataset (CK+): A complete dataset for action unit and emotion-specified expression" Computer Vision and Pattern Recognition Workshops (CVPRW), 2010 IEEE Computer Society Conference on. IEEE, 2010
[9] Sranya et.al, "Human Expression Recognition using Facial Features" International Journal of Computer Applications® (IJCA) (0975 – 8887) International Conference on Knowledge Collaboration in Engineering, ICKCE-2014

[10] Faten Bellakhdhar, Kais Loukil, Mohamed ABID, computer embedded system, University of Sfax 2012 "SVM classification for face recognition" Journal of intelligent computing volume 3 Number 4 December

[11] G.U.Kharat, S.V. Dudul, 2009 " Emotion Recognition from facial expression using neural networks" Human computer systems interaction advances in intelligent and soft computing

[12] Priya Metri1, Jayshree Ghorpade and Ayesha Butalia,Department of Computer Engineering, MITCOE "Facial Emotion Recognition Using Context Based Multimodal Approach" Int. J. Emerg. Sci., 2(1), 171- 182, March 2012 ISSN: 2222-4254 © IJES 171, Pune

[13] V Soroosh Mariooryad, Student Member, IEEE, and Carlos Busso, Member, IEEE.Ding, W. and Marchionini, G. 2013 "Exploring Cross-Modality Affective Reactions for Audiovisual Emotion Recognition" IEEE Transactions On Affective Computing, Vol. 4, No. 2, April-June

[14] Lin "Facial Expression Recognition Based on Geometric Features and Geodesic Distance" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol.7, No.1 (2014), pp.323-330

[15]F. Lavagetto and R. Pockaj "An efficient use of MPEG-4 FAP interpolates for facial animation at 70 bits/frame" Circuits and Systems for Video Technology, vol. 11, no. 10, (2001), pp. 1085-1095

[16]S. Sebastian and A. Fink Gernot "A New Method for Combined Face Detection and Recognition Using Interest Point Descriptors" In International Conference on Automatic Face & Gesture Recognition and Workshops, (2011), pp. 219-523

[17] D. V. Jadhav and R. S. Holambe "Feature extraction using radon and wavelet transform with application to face recognition" Neuro-computing, vol. 72, no. 7-9, (2009), pp. 1951-1959

[18] R.Xiao "Facial Expression Recognition on Multiple Manifolds" Pattern Recognition Volume 44, Issue 1, January 2011, Pages 107–116

[19] Jharna "Human Face Expression Recognition" International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 7, July 2014)

[20] S.P.Khandait, Dr. R.C.Thool and P.D.Khandait "Automatic Facial Feature Extraction and Expression Recognition based on Neural Network" (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 2, No.1 (January 2011)

[21] Rupinder Saini, 2Narinder Rana "FACIAL EXPRESSION RECOGNITION Techniques, Database & Classifiers" International Journal of Advances in Computer Science and Communication Engineering (IJACSCE) Vol 2 Issue2 (June 2014)

[22] M. Agrawal, N. Jain, M. Kumar and H. Agrawal "Face Recognition using Eigen Faces and Artificial Neural Network" International Journal of Computer Theory and Engineering, August 2010

[23] Yang, Songfan, and BirBhanu "Facial expression recognition using emotion avatar image" Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on. IEEE, 2011

[24] Z. Wang, S. Wang, and Q. Ji "Capturing complex spatiotemporal relations among facial muscles for facial expression recognition" in Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR '13), pp. 3422–3429, 2013

[25] Saudagare, Pushpaja V., and D. S. Chaudhari "Facial Expression Recognition using Neural Network–An Overview" International Journal of Soft Computing and Engineering (IJSCE) 2.1 (2012): 224-227