*IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE)*
*e-ISSN: 2278-1676,p-ISSN: 2320-3331, Volume 14, Issue 3 Ser. I (May. – June. 2019), PP 15-22*
*www.iosrjournals.org*

# Adaptive Neuro Fuzzy Inference System for Facial Recognition

Vinodpuri Rampuri Gosavi*[a,b] , Dr. Anil Kishanrao Deshmane[1],
Dr. Ganesh Shahuba Sable[2a],
*[a,b,2a] G. S. Mandal's, M.I.T., Aurangabad, Maharashtra, India; [1]J.S.P.M.'s ,B.I.T., Barshi, Solapur, Maharashtra, India*
**Department of Electronics & Telecommunication Engineering , Faculty of Science & Technology, G. S. Mandal's , Maharashtra Institute of Technology , Aurangabad, MS, India;*

***Abstract:*** *An image processing is an interesting topic to distinguish the human actions for overall life presentations. For instance, detecting the gesticulation of an individual when he or she is driving and warning him/her when he/she is in sleepy attitude will be fairly beneficial. Human motions can be recognized by detecting the dissimilar movements of iris, nose, mouth localization and pointers. In this research we are concentrating on the humanoid face for identifying appearance. Many practices are obtainable to distinguish face. In this paper, the main focus is given in the feature extraction approach and also the classification approach. The feature extraction is done by using principal component analysis and the classification is done by using Adaptive Neuro Fuzzy Inference System .*

***Keywords:*** *Recognitions, Automatic Classifications, Characteristic Extractions, Neuro Fuzzy Systems, Feature extractions.*

---

Date of Submission: 26-04-2019 Date of acceptance: 11-05-2019

---

## I. Introduction

Facial terminologies are the consequences which deals with the set of facial muscle over a period. These activities interrelate in dissimilar patterns and transport different terminologies. Accepting such complex face mask action not only needs to read each separate facial motion of the muscle, but also the interaction among each other in the time domain [1-3].In these domains, facial muscle can occur or mutually limited at each interval portion. Temporally, the measure of facial based muscles can stimulate, join or follow alternative influence. These relations detect significant data about facial, somewhat due to the boundaries of the current representations. Most of the present works that achieve facial appearance recognition, we developed a facial recognition system as a composite action that distances above a time break and involves a collection of facial events consecutively or parallel. More prominently, exhibiting facial recognitions is a complex motion which allows us to additional training and capture a superior variety of compound spatial and sequential interactions between the original events. In this work, the main aim is to build an automatic classification system which deals with the high feature extraction and less error rate probability systems with less false acceptance rates [3-7].

Accepting a composite activity and catching the fundamental temporal associations is stimulating and most of the present approaches do not grip this skillfully. Modeling and distinguishing a multifarious movement is unsurprisingly resolved by construction of an arrangement which deals with the capture of the spatial relationships between primitive proceedings. Among numerous visual gratitude procedures, like graphical, explanation based methods, hidden Markov models and networks have developed the most prevalent tool for demonstrating and thoughtful complex actions [11-13]. While these methods have been functional to seizure the changing aspects of facial terminologies which deals with the following matters when demonstrating and understanding compound activities that deals with the interactions among different objects over periods of time. Firstly the graphical models typically characterize an action which is commonly impractical for facial appearance. Figure 1 shows the various sample facial rotations and sample images which are used for experimentation purpose.

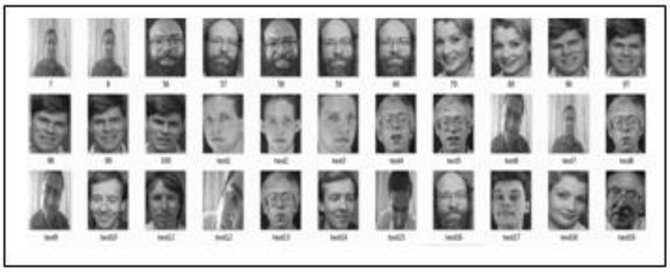


**Fig 1** Various Facial Rotations and Actions

Face acknowledgment should be possible in both a still picture and video arrangement which has its starting point in still-picture confront acknowledgment. Diverse methodologies of face acknowledgment for still pictures can be arranged into tree principle gatherings, for example, the encompassing methodology, include based approach, and half and half approach [16-18]. It is based on methodologies highlight that is the highlights on face, for example, nose, and afterward eyes are fragmented and after that utilized as information for basic classifier [8]. Unmodified geometry, dynamic connection engineering, and Markov demonstrate strategies have a place with the classification scenario. A standout among the best frameworks is the Elastic Bunch Graph Matching (EBGM) framework, which depends on DLA. Wavelets, particularly Gabor wavelets, assuming a building square part for facial portrayal in the coordinating strategies [9]. A normal nearby component portrayal comprises of wavelet coefficients for various scales and turns in light of settled wavelet bases. These privately assessed wavelet coefficients are hearty to brighten the change, interpretation, mutilation, pivot, and scaling. The lattice is suitably situated over the picture and is put away with every matrix point's privately decided stream and serves to speak to the example classes [10][11]. Acknowledgment of another picture happens by changing the picture into the matrix of planes, and coordinating all put away model diagrams to the picture. Adaptation of the DLA is finished by setting up and powerfully adjusting joins between vertices.

## II. Proposed Work

The proposed development phase deals with the efficient collaboration of PCA named as principal component analysis and ANFIS (Adaptive Neuro Fuzzy Inference System).

### 2.1 PCA (Principal Component Analysis)

Principal Component Analysis (PCA) is a straightforward yet well-known and valuable direct change procedure that is utilized as a part of various applications; for example, securities exchange expectations, the investigation of quality articulation information, and some more. Figure 2 gives the graphical representation of 2D to1D & 3D to 2D. In this instructional exercise, PCA isn't only a "black box", and we will unwind its internals in below mentioned procedure

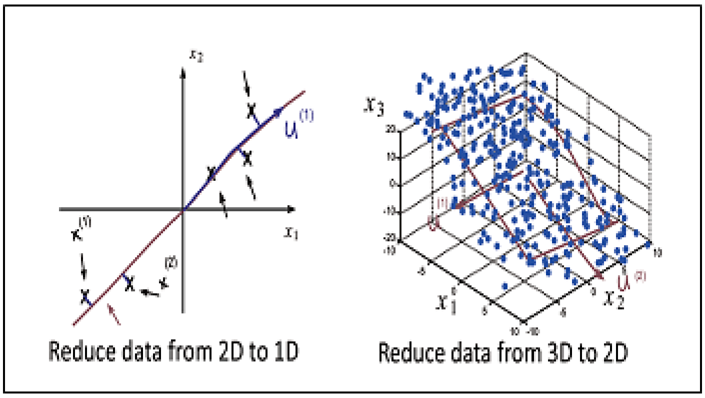



**Fig 2** PCA dimensionality reduction

1. Acquire the Eigenvectors and Eigenvalues from the covariance lattice or relationship framework, or perform Singular Vector Decomposition.
2. Sort eigenvalues in plummeting request and pick the k eigenvectors that relate to the k biggest eigenvalues where k is the quantity of measurements of the new component subspace (k≤d )/.
3. Build the projection framework W from the chose k eigenvectors.
4. Change the first dataset X by means of W to acquire a k-dimensional component subspace Y.

**2.2 ANFIS (Adaptive Neuro-Fuzzy Inference System)**

The essential structure of Mamdani fuzzy derivation framework is a model that maps input qualities to include participation capacities, input enrollment capacities to rules, principles to an arrangement of yield attributes, yield attributes to yield enrollment capacities, and the yield participation capacities to a solitary esteemed yield or a choice related with the yield. Figure 3 shows structure of ANFIS. Such a framework utilizes settled enrollment works that are picked discretionarily and a decide structure that is basically foreordained by the understanding of the attributes of the factors in the model.

ANFIS and the Neuro-Fuzzy Designer apply fuzzy inference systems for demonstrating essential information. As it is noticed from the other fluffy deduction GUIs, the state of the enrollment capacities relies upon parameters, and changing these parameters change the state of the participation work. Rather than simply taking a approximations of the information to pick the enrollment work parameters, we will pick participation work parameters naturally utilizing these Fuzzy Logic Toolbox applications

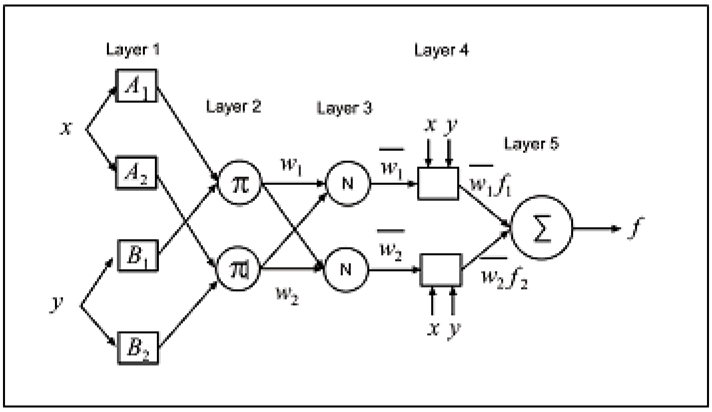



**Fig 3** ANFIS architecture

## III. Proposed Flow diagram

Figure 4 & 5 gives the basic proposed flow structure of work and sample images of JAFFE data base respectively . The methodology is used as below:

***Methodology steps***

1. Initialize the process
2. Firstly GUI process will take place for the human machine interaction
3. Then facial samples will be uploaded to train the system based on the extraction of features
4. Then the normalization of the image samples will take place
5. Feature vectors are extracted in terms of Eigen values using PCA (Principal component analysis)
6. Then we will save the feature vector in the database
7. Perform Classification using Adaptive Neuro Fuzzy Inference System
8. Evaluation of system's performance in terms of positive rate, negative rates, sensitivities, specificity and recognition accuracy
9. Stop

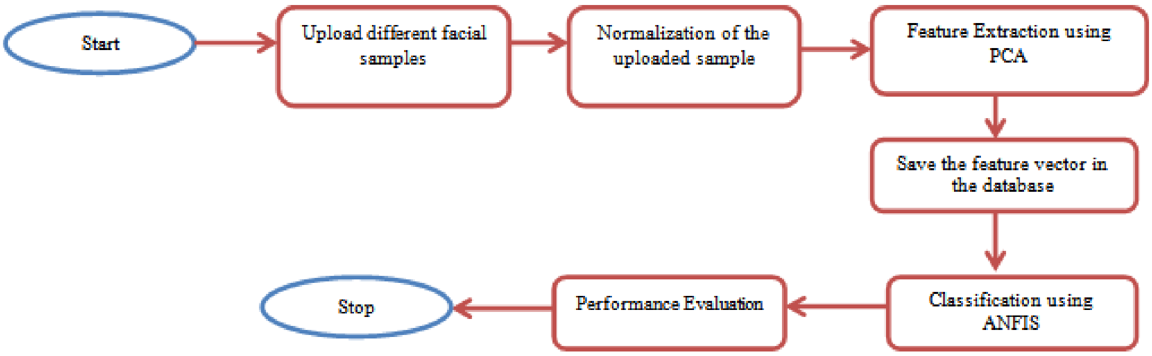



**Fig.4** Proposed Flow Diagram

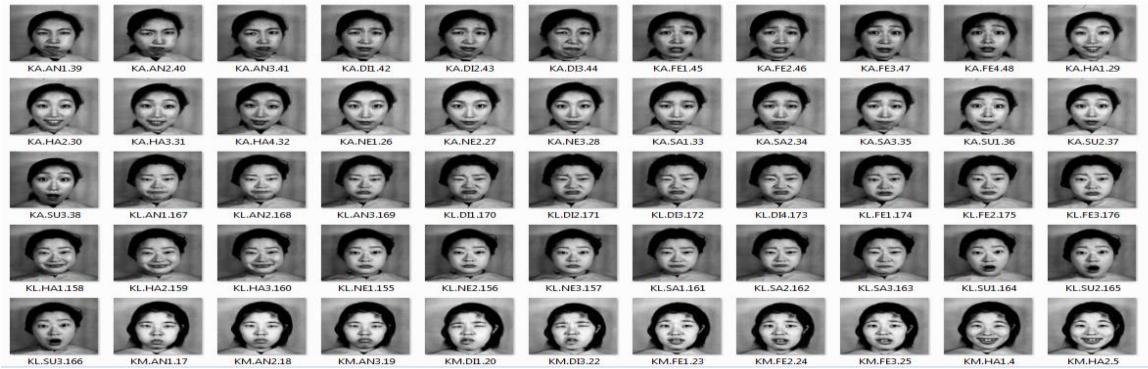



**Fig 5:** Sample of face images from JAFFE database

## IV. Results And Discussion

In each process the appropriate outcome is one of the vital situations for the advancement of any continuous real time process and programmed acknowledgment based on confirmations. So this section manages the proficient discussion based on the proposed developed system which brings in the MATLAB environment. This section deals with the efficient discussion based on the feature extraction and the classification results which will provide high authenticity and novelty of the work.

The proposed Adaptive Neuro Fuzzy Inference system is tested on JEFFE database [22] . Figure 5 shows JAFFE database which is used for testing the system . The database contains 213 images of 7 facial expressions (6 basic facial

expressions + 1 neutral) posed by 10 Japanese female models. Each image has been rated on 6 emotion adjectives by 60 Japanese subjects. The database was planned and assembled by Michael Lyons, Miyuki Kamachi, and Jiro Gyoba. The photos were taken at the Psychology Department in Kyushu University . We have used Matlab 2015a for testing the system .

We have considered more number of images for testing the proposed system from JAFFE database . The fig 6 shows the uploading of the image samples and the pre-processing of the uploaded samples and shows that, the detected boundaries by using edge detection especially the canny edge detector is

used to achieve the appropriate and cleared output image sample


**Fig 6** Uploading and Pre-processing

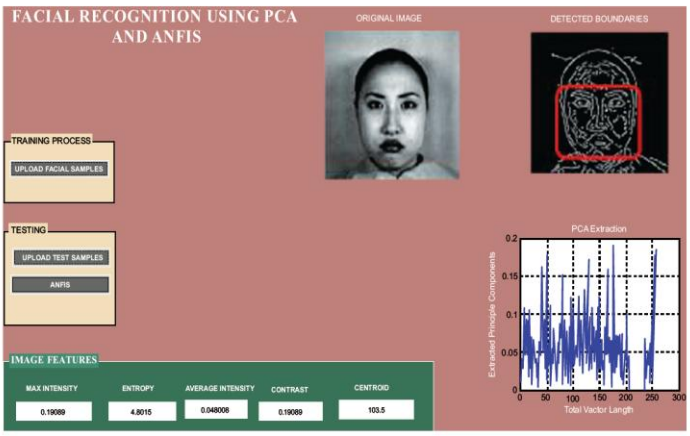



**Fig 7** Training the Sample Images

Fig 7 shows the training the sample images and the result of various parameters of images are summarized as in Table 1 shows the extracted feature values in terms of maximum intensity, entropy, average intensity, contrast and centroid and are saved in the database which is one of the crucial step in training process

**Table 1** Sample Parameters of Training Image

| Max Intensity | Entropy | Average Intensity | Contrast | Centroid |
|---|---|---|---|---|
| 0.19089 | 4.08015 | 0.048008 | 0.19089 | 103.5 |

Various Parameters are represented in figure 8 shows max intensity , Fig 9 shows centroid and fig 10 shows average intensity of test images

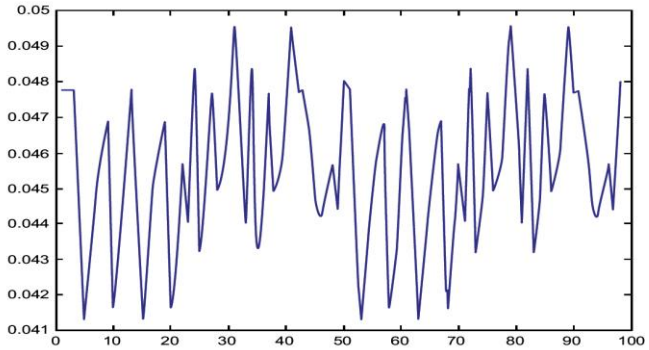



**Fig 8** Max Intensity of Test Image

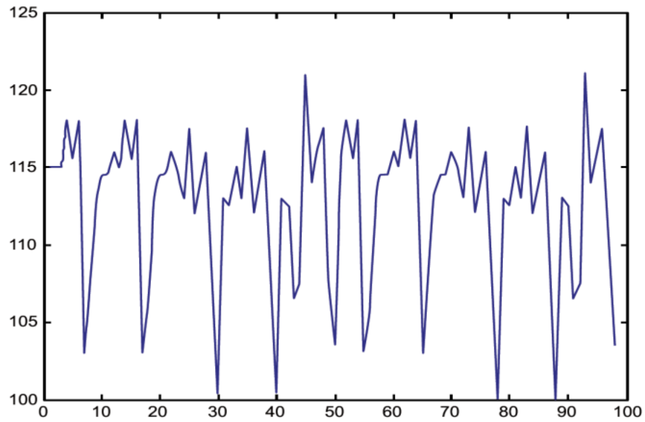



**Fig 9** Centroid

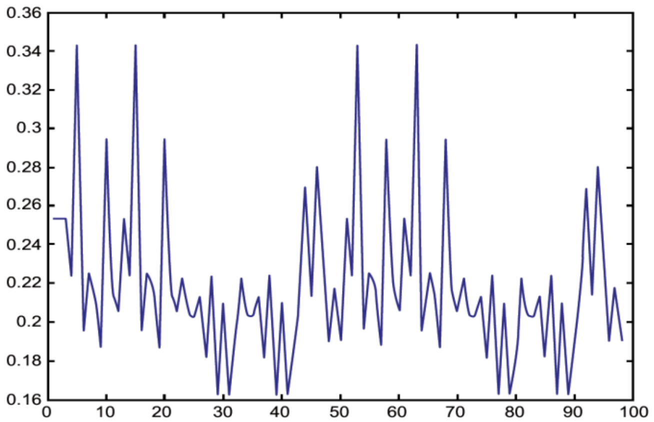



**Fig 10** Average Intensity of Test Images


**Fig 11** Classification and Recognition

Fig 11 shows the testing images and result of such testing images is summarized in table II . The fig 11 shows the classification result which is done by the ANFIS system and shows that the classification is done in an appropriate manner. And the record is matched with the right individual

**Table 2** Distinguish parameters of test Image

| Max Intensity | Entropy | Average Intensity | Contrast | Centroid |
|---|---|---|---|---|
| 0.22534 | 4.7123 | 0.045003 | 0.22534 | 103 |

Table III shows various performance parameters are being calculated for getting 100% fast recognition. It shows better result as compared with other system existed.

Table III shows the specificity and sensitivity which shows the true positive rates which must be high for the efficient authenticates which must be high for the high efficient recognitions of the system.

The recognition rate which must be high for the recognition of the right individual and shows that the recognition is coming 0.92 in terms of probability and 92.03 % in terms of high recognition rates.

The false positive rate and false negative rates which is 0.07 and 0.04 which is coming very less and it must be low for the high stability and false detections of the individual samples.

The true positive rate and true negative rate which is 0.86 and 0.95 it must be high which shows that the features of the test sample is closely matched with the training database which must be high for the high recognitions with less error rate probabilities

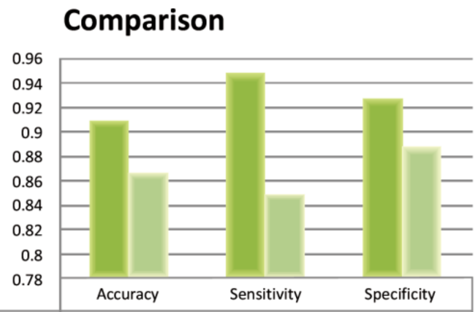
**Table 3** Performance Parameters to Test system efficiency

| Parameters | ANFS |
|---|---|
| Accuracy | 0.9285 |
| Sensitivity | 0.9468 |
| Specificity | 0.9263 |
| False Negative | 0.0487 |
| False Positive | 0.0743 |
| True Negative | 0.9513 |
| True Positive | 0.8657 |

The proposed system is compared with available FFBNN and we found that our system gives better result . Table IV shows comparison of ANFS with FFBNN.

**Table 4** Comparison of ANFIS with FFBNN

| Performance Parameters | | |
|---|---|---|
| Parameters | For ANFS | For FFBNN |
| Accuracy | 0.9285 | 0.8666 |
| Sensitivity | 0.9468 | 0.8481 |
| Specificity | 0.9263 | 0.8873 |




| | Accuracy | Sensitivity | Specificity |
|---|---|---|---|
| Performance Parameters For ANFS | 0.9085 | 0.9468 | 0.9263 |
| Performance Parameters For FFBNN | 0.8666 | 0.8481 | 0.8873 |

**Fig 11** Comparison of ANFS with FFBNN

## V. Conclusion

This paper deals on the comprises of the efficient training and testing of the facial systems for the high recognition rates and less error rate probabilities and shows that the developed system is well robust to achieve high true positive rates and low false positive rates. The developed system deals with the normalization of the image samples using filtering process which filters out the redundancies in the image and also the feature extraction process using principal component analysis and the classification approach using ANFIS (Adaptive Fuzzy Inference System) which shows the robust of the proposed system to achieve high recognition rates of right authentic user to recognize the face from the training dataset in the testing phase.

## References

[1]. Q. Wu, Z. Wang, F. Deng, Z. Chi, D. D. Feng, "Realistic human action recognition with multimodal feature selection and fusion", IEEE Transactions on Systems, Man, and Cybernetics: Systems 43, no. 4 (2013): 875-885.

[2]. Cohen, N. Sebe, L. Chen, A. Garg, and T. S. Huang. Facial expression recognition from video sequences: Temporal and static modelling. In Computer Vision and Image Understanding, pages 160– 187, 2003.

[3]. C. P. de Campos, Z. Zeng, and Q. Ji. Structure learning of Bayesian networks using constraints. In ICML, 2009.

[4]. S. Jain, C. Hu, and J. K. Aggarwal. Facial expression recognition with temporal modeling of shapes. In ICCV Workshops, pages 1642– 1649.IEEE, 2011.

[5]. R. E. Kaliouby and P. Robinson. Real-time inference of complex mental states from facial expressions and head gestures. In CVPR Workshop, 2004.

[6]. G.C. Littlewort, M.S. Bartlett , L.P. Salamanca, J.Reilly, "Automated measurement of children's facial expressions during problem solving tasks", Automatic Face & Gesture Recognition and Workshops, IEEE International Conference ,pp. 30-35, IEEE, 2011.

[7]. Z. Wang, S. Wang, Q. Ji, "Capturing complex spatio-temporal relations among facial muscles for facial expression recognition", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 3422-3429, IEEE, 2013.

[8]. Reecha Sharma, M.S. Patterh , "A new pose invariant face recognition system using PCA and ANFIS " , Optik 126 (2015) 3483–3487, www.elsevier.de/ijleo

[9]. Okada K., Steffans J., Maurer T., Hong H., Elagin E., Neven H., Andmalsburg C. V. D., (1998). The Bochum/USC Face Recognition System and how it fared in the FERET Phase III Test. In Face Recognition: From Theory to Applications, Eds. Springer-Verlag, Berlin, Germany, (1998) 186-205.

[10]. Wiskott L., Fellous J.-M., and Von dermalsburg C., (1997), Face recognition by elastic bunch graph matching. IEEE Trans. Patt. Anal. Mach. Intell. 19, (1997) 775-779.

[11]. J. Buhman,M. Lades, and C.V.D. Malsburg, (1990), Size and distortion invariant object recognition by hierarchical graph matching. In Proceedings, International Joint Conference on Neural Networks. (1990) 411-416.

[12]. F. Schroff, D. Kalenichenko, J. Philbin, "A unified embedding for face recognition and clustering", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 815-823, IEEE, 2015.

[13]. L. Shang and K.-P.Chan. Nonparametric discriminant hmm and application to facial expression recognition. In Computer Vision and Pattern Recognition, IEEE Conference on, pages 2090–2096, June2009. 1, 2

[14]. M. F. Valstar and M. Pantic. Induced Disgust, Happiness and Surprise:an Addition to the MMI Facial Expression Database. In Proceedings of Int'l Conf. Language Resources and Evaluation, Workshop on EMOTION, pages 65–70, Malta, May 2010.

[15]. M. F. Valstar and M. Pantic. Fully automatic recognition of the temporal phases of facial actions. IEEE Transactions on Systems, Man,and Cybernetics, Part B, pages 28–43, 2012.

[16]. Z. Zeng, M. Pantic, G. Roisman, and T. Huang. A survey of affect recognition methods: Audio, visual, and spontaneous expressions. Pattern Analysis and Machine Intelligence, IEEE Transactions on,31(1):39–58, Jan 2009.

[17]. C. Ding, J. Choi, D. Tao, L.S. Davis, "Multi-directional multi-level dual-cross patterns for robust face recognition", IEEE transactions on pattern analysis and machine intelligence, pp.518-531, 2016.

[18]. F. Schroff, D. Kalenichenko, J. Philbin, " Facenet: A unified embedding for face recognition and clustering", In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, pp. 815-823, IEEE, 2015.

[19]. C. Liu, J. Yuen, A. Torralba, "Sift flow: Dense correspondence across scenes and its applications", In Dense Image Correspondences for Computer Vision, pp. 15-49. Springer, Cham, 2016

[20]. M. Sharif, S. Bhagavatula, L. Bauer, M. K. Reiter. "Accessorize to a crime: Real and stealthy attacks on state of-the-art face recognition." In Proceedings of the 2016 ACM SIGSAC Conference on Computer and Communications Security, pp. 1528-1540.ACM, 2016.

[21]. T. Baltrušaitis, P. Robinson, L. P. Morency, "Openface: an open source facial behavior analysis toolkit." In Applications of Computer Vision (WACV), 2016 IEEE Winter Conference on, pp. 1-10.IEEE, 2016.
[22]. A. Mollahosseini, D. Chan, M. H. Mahoor, "Going deeper in facial expression recognition using deep neural networks", In Applications of Computer Vision (WACV), 2016 IEEE Winter Conference on, pp. 1-10. IEEE, 2016.
[23]. Michael J. Lyons, Shigeru Akemastu, Miyuki Kamachi, Jiro Gyoba. Coding Facial Expressions with Gabor Wavelets, 3rd IEEE International Conference on Automatic Face and Gesture Recognition,pp.200-205(1998).
[24]. James A. Rodger, Toward reducing failure risk in an integrated vehicle health maintenance system: A fuzzy multi-sensor data fusion Kalman filter approach for IVHMS Expert Systems with Applications, Volume 39, Issue 10, August 2012, Pages 9821-9836

Vinodpuri Rampuri Gosavi. "Adaptive Neuro Fuzzy Inference System for Facial Recognition." IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE) 14.3 (2019): 15-22.