Facial Expression Recognition Method Using Hybrid DWT and Random Forest Classification

[1]Rama Das, [2]Ekta Tamrakar

[1]Research Scholar, [2]Assistant Professor
[1,2]Department of Electronic Engineering
Bhilai Institute of Technology, Durg C.G.

***Abstract*: As the applications are getting closer to daily use and keeps a record of individual activities, the instance of accuracy about identity of an individual is largely solicited. As the face recognition have pounding benefits over other commercial algorithms and human eyes can easily analyze the output, this technique is constantly being upgraded with better algorithms and lower computation cost.**

The face though seems an easy object to be recognized by retina but the artificial intelligence is not yet intelligent enough to do the task easily. As the source of a face is generally an image capturing object, there are lot of variations and complexions that persists with the image like (for example: noise, rotation etc.). There are many techniques that use some or other algorithm to find similarity in face model and the test image and most of them are successful on their part to attain better test similarities. However, considering the diverse scale of applications and mode of image sourcing, a single algorithm cannot get maximum efficiency everywhere. Even after using the best algorithm for a particular task, an application has to counter with challenges of facial expression recognition.
The primary objective of this research work is to analyze the Hybrid approach of Harris Corner and DWT (Discrete Wavelet Transform) features for facial expression recognition. A subspace is created by this algorithm for training of feature vectors and Random Forest classifier calculates the similarity score for performance evaluation which will provide improved results in terms of recognition accuracy.

Keywords: Confusion Matrix Plot, DWT, Harris Corner, Random Forest Classifier, Viola Jones Method.

I. INTRODUCTION

The biometric recognition techniques, also termed as Biometrics is the process of identifying an individual with due of their physiological and behavioural patterns. Being the high diversity in characteristics, biometrics has achieved high interest among the researchers to classify an individual. Some of most profitable features that possess unique behaviour like face, fingerprint, hand geometry, iris, signature, DNA (Deoxyribonucleic Acid) etc. have respective importance to identify an individual. Out of these face consists of numerous distinctive points that could be associated in an algorithm of classifying patterns. Face biometrics do not require an individual to be present near identification system as the systems are self-sufficient to execute algorithms using face images as input. This property is exploited in various security applications such as surveillance at public places (for example: airports, banks, traffic signals, train platforms, bus stations etc.). Images captured at any location, filter the face areas and match with existing database of suspected people. The systems are designed to work unremitted with less human efforts and acceptable level of precision.

In social life aspects, the accuracy of facial expression recognition is concerned with low attention. The database consist only limited number of images (friends, family etc.) and the test inputs usually are among them only. In the broader domain, i.e. security, research and intelligence services the accuracy in face detection and recognition is mandatory aspect considering the database size and acceptable range of errors. The systems such as income tax, subscribers' identity module, and government services accustom the people's information for the whole country. The subjects in information consist of whole families (whose facial features resemble each other to a great extent) and twins.

With the rapid increase of computational powers and availability of recent sensing, investigation and representation equipment and technologies, computers are becoming extra and more intelligent. Numerous research projects and commercial products have demonstrated the capability for a computer to interact with human in a natural way by looking at people through cameras, listening to citizens through microphones, and reacting to people in a friendly behavior. One of the fundamental techniques that enables such natural human-computer interaction (HCI) is face detection. Face detection is the step stone to the entire facial analysis algorithms, including face alignment, face relighting, face modeling, face recognition, head pose tracking, face verification / authentication, facial expression tracking/recognition, gender/age recognition, and lots of more. Only when computers can recognize face well will they begin to truly understand people‘s thoughts and intentions[2].

Facial expression recognition plays important role in a variety of applications such as automated tools for behavioral research, bimodal speech processing, video conference, airport security and access control, building (embassy) surveillance/monitoring, human computer intelligent interaction and perceptual interfaces, etc. Various methods for recognizing human facial expressions from face images have been proposed and their performance has been evaluated with databases of face images with variations in expressions. Generally, there are two categories of feature representation: geometric features and appearance feature. Appearance features have been demonstrated to be better than geometric features, because geometric features are very sensitive to noises,

especially illumination noise. Local Binary Patterns (LBP) is a powerful means of texture description. The block-based approach based on local binary patterns is extended for facial expression recognition[3].

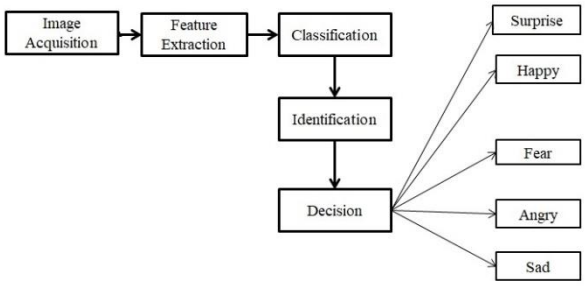

Figure 1: Facial Expression Recognition Method

II. METHODOLOGY

Facial expression recognition using extraction of Harris Corner and DWT (Discrete Wavelet Transform) features is proposed in this heading. In domain of inductive inference problem, source separation could be a challenging task. As to derive the solution one needs the sufficient information, the available information is exploited in maximum limits. The adaptive systems tend to inherit most of the available feature information to replicate the original set of input with elaborated clarity. The efficiency of an algorithm is subjected to its performance in case when evaluation parameters reflect sound values even in cases of noise, orientation and luminance conditions.

In this proposed research work the process of face recognition is a sequential task. The methods of face recognition are generally studied in three domains that are classified based on their approach. The template matching methods identifies the group of pixels in test image that resembles with the template image.

The geometrical local-feature-based methods concentrate on geometries of faces and select the relative sets of features for matching. Hybrid methods is the smart acquisition of template based approaches. Though the schemes are successful in their part of applications with supporting assumptions, they do possess certain advantages and disadvantages. One can say that the selection of algorithm should be subjected to the required task in a given application.

III. RESULTS AND DISCUSSIONS

The Japanese female face expression (JAFFE) Database: The information contains 213 pictures of seven facial expressions (6basic facial expressions + one neutral) display by ten Japanese feminine models. every image has been rated on half-dozen feeling adjectives by sixty Japanese subjects. The photos were taken at the department of psychology in Kyushu University.

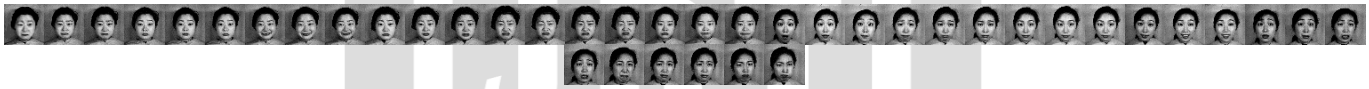

Figure 2: Test images for JAFFE (Japanese female facial expression) [45]

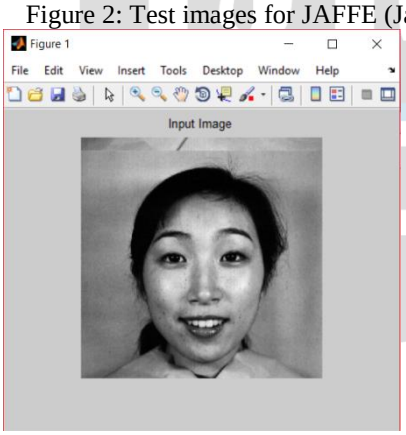

Figure 3: Input image

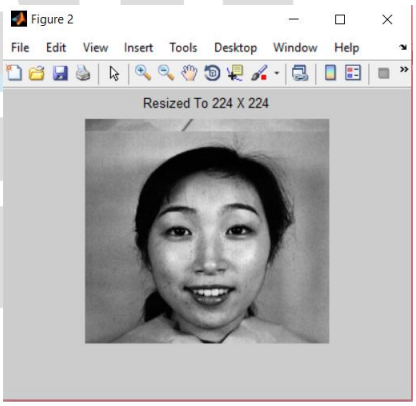

Figure 4: Resized to 224×224

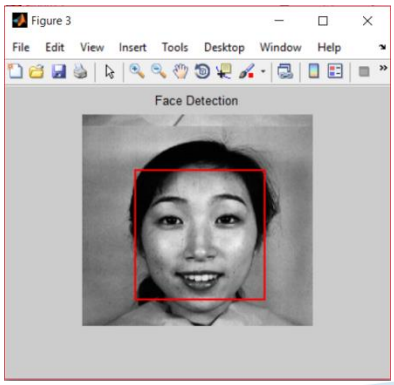

Figure 5: Face detection using Viola Jones method

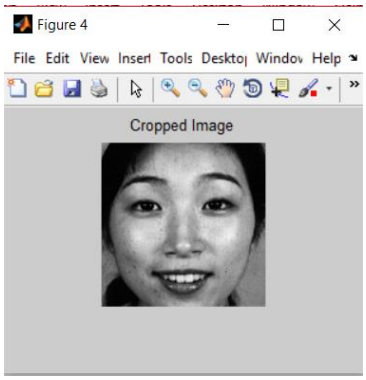

Figure 6: Cropped image

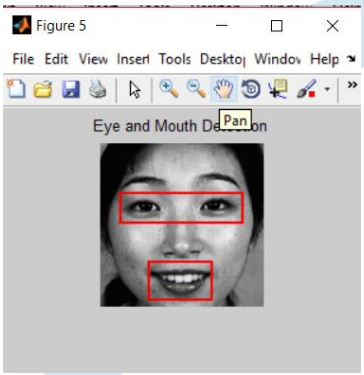

Figure 7: Eye and mouth detection

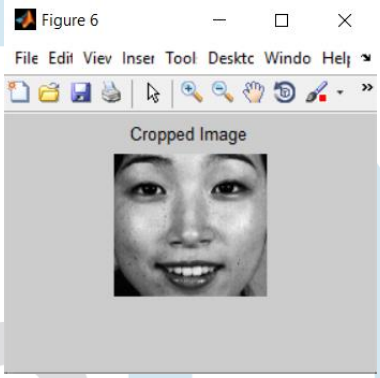

Figure 8: Cropped image

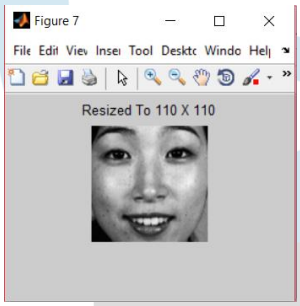

Figure 9: Resized to 110×110

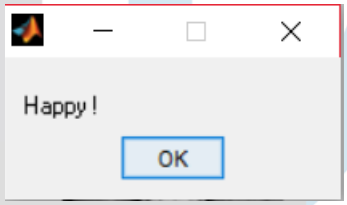

Figure 10: Recognized Result

In proposed Random Forest classifier based approach there is not any threshold value for face recognition. Random Forest Classifier itself does the similarity measure and recognizes test image. Finally, confusion matrix plot show the performance of Harris Corner and DWT based method.

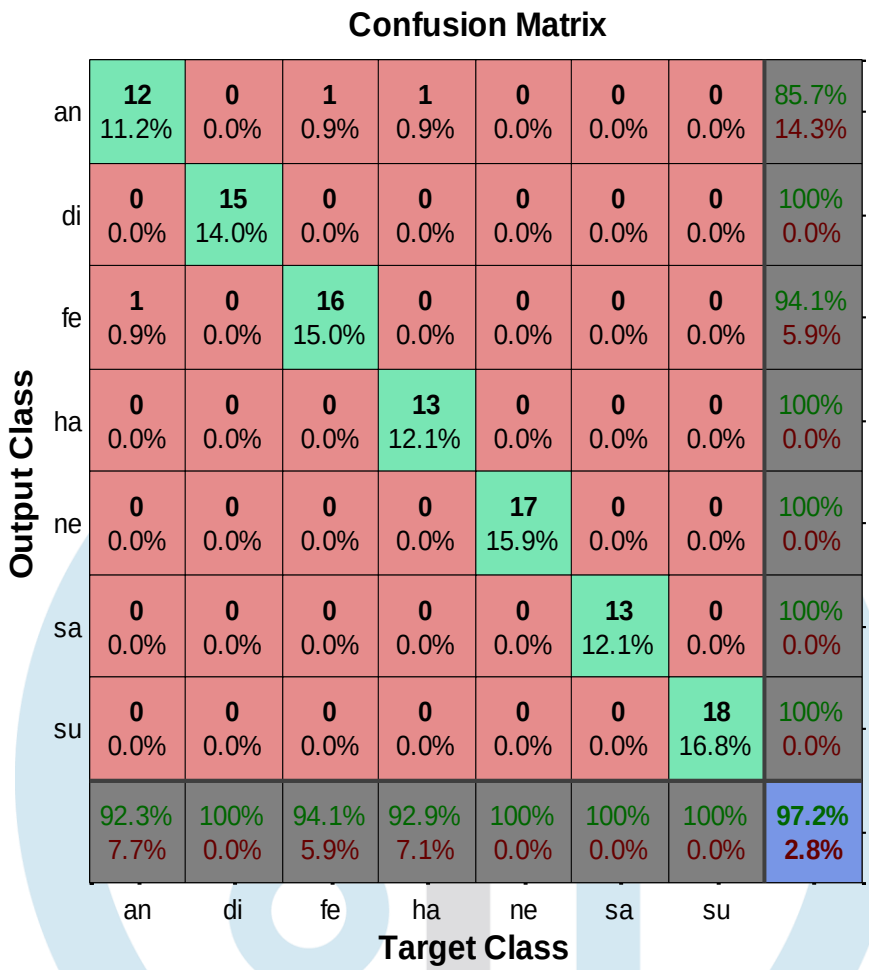

Figure 11: Confusion Matrix plot for proposed approach

The row and column are the classes of facial expression database. There are 7 sets of classes and each class having different set of expressions. The confusion matrix plot indicates the accuracy i.e. 97.2% for proposed algorithm.

Table 1: Notations for expression

S.No.	Abbreviation	Meaning
1	An	Angry
2	Di	Disgust
3	Fe	Fear
4	Ha	Happy
5	Ne	Neutral
6	Sa	Sad
7	Su	Surprise

Table 2: Comparison of result with previous research works

Experiments		Recognition Rate (Accuracy In %)						
		An	Di	Fe	Ha	Ne	Sa	Su
Previous Research	[28]	23.1	66.7	58.3	63.5	--	36.7	66.7
	[29]	96.7	82.8	84.4	83.9	93.3	83.9	80
	[30]	88	73	73	78	--	81	85
JAFFE Database Stage-I - 7 emotions	Method 1 [3]	100	90	100	95	100	75	95
	Method 2 [3]	100	85	95	90	85	80	90
	Method 3 [3]	100	80	90	95	85	70	85
JAFFE Database Stage-II - 5 emotions	Method 1 [3]	90.47	61.9	----	61.9	80.9	---	57.1
Proposed Approach: 7 emotions	**Using Random Forest Classifier**	**92.3**	**100**	**94.1**	**92.9**	**100**	**100**	**100**

IV. CONCLUSION

The foremost use of face expression recognition is in security functions, nevertheless the technical advancements integrated this technology in gift technical applications cherish smile detection in private etc. Face recognition is beneficial in cases once an individual adopts disguise appearance and makes laborious for human eyes to acknowledge. The applications of face recognition are crucial in security aspects thence the necessity of this analysis is even. However, the face recognition isn't straightforward in computing and suffers varied challenges and therefore the method includes a specific model to follow.

This analysis work presents options face expression recognition system victimization extraction of Harris corner and DWT features classified by Random Forest Classifier. Confusion matrix demonstrates that the projected random forest based mostly approach offers additional accuracy than the previous analysis works.

V. FUTURE SCOPE

Face recognition technology is deployed with certain constraints, the over performance of the systems is healthier once frontal mug-shot pictures with correct luminance conditions area unit out there. The face recognition algorithms works well within the most sensible conditions wherever the systems aren't outlined to perform beneath completely different physical conditions (for example: night, sunset, dawn). the long run systems area unit expected to spot a personal problem free in numerous operational conditions and constraints. The identification systems with sturdy outputs can not be relied on singular modality as the presence of noise and illumination variations will hamper the output. Generally a system is enabled with fusion of modalities and sensible setting area unit

created wherever users will act freely. wearable systems have a small sized sensing technology that consumes less power and simply integrated with vesture and accessories..

REFERENCES

[1] M. Chauhan, "Study & Analysis of Different Face Detection Techniques", International Journal of Computer Science and Information Technologies, Vol. 5 (2) , 2014

[2] V. Gupta et. al."A Study of Various Face Detection Methods", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 3, Issue 5, May 2014

[3] Mehta, Neelum, and Sangeeta Jadhav. "Facial Emotion recognition using Log Gabor filter and PCA." In Computing Communication Control and automation (ICCUBEA), 2016 International Conference on, pp. 1-5. IEEE, 2016.

[4] Yovel, Galit, Jeremy B. Wilmer, and Brad Duchaine. "What can individual differences reveal about face processing?." Frontiers in human neuroscience 8, 2014.

[5] Bettadapura, Vinay. "Face expression recognition and analysis: the state of the art." arXiv preprint arXiv:1203.6722(2012).

[6] Yu, Zhiding, and Cha Zhang. "Image based static facial expression recognition with multiple deep network learning." Proceedings of the 2015 ACM on International Conference on Multimodal Interaction. ACM, 2015.

[7] Valstar, Michel F., et al. "The first facial expression recognition and analysis challenge." Automatic Face & Gesture Recognition and Workshops (FG 2011), 2011 IEEE International Conference on. IEEE, 2011.

[8] Rivera, Adin Ramirez, Jorge Rojas Castillo, and Oksam Oksam Chae. "Local directional number pattern for face analysis: Face and expression recognition." IEEE transactions on image processing 22.5 (2013): 1740-1752.

[9] Bänziger, Tanja, and Klaus R. Scherer. "Introducing the geneva multimodal emotion portrayal (gemep) corpus." Blueprint for affective computing: A sourcebook (2010): 271-294.

[10] Dhall, Abhinav, et al. "Emotion recognition in the wild challenge 2014: Baseline, data and protocol." Proceedings of the 16th International Conference on Multimodal Interaction. ACM, 2014.

[11] Eckert, Martina, et al. "Fast facial expression recognition for emotion awareness disposal." Consumer Electronics-Berlin (ICCE-Berlin), 2016 IEEE 6th International Conference on. IEEE, 2016.

[12] Liu, Ping, et al. "Facial expression recognition via a boosted deep belief network", Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2014.

[13] Sandbach, G.; Zafeiriou, S.; Pantic, M.; Rueckert, D. Recognition of 3D facial expressions dynamics. Image Vision Comput 2012, 762–773.

[14] Rudovic, O.; Pantic, M.; Patras, I. Coupled Gaussian processes for pose-invariant facial expression recognition. IEEE Trans. Pattern Anal. Mach. Intell.2012, 35, 1357–1369.

[15] Ghimire, Deepak, and Joonwhoan Lee. "Geometric feature-based facial expression recognition in image sequences using multi-class adaboost and support vector machines." Sensors13.6 (2013): 7714-7734.

[16] Zhao, X.; Zhang, S. Facial expression recognition based on local binary patterns and kernel discriminant isomap. Sensors 2011, 11, 9573–9588.

[17] Moore, S.; Bowden, R. Local binary patterns for multi-view facial expression recognition. Comput. Vision Image Underst. 2011, 115, 541–558.

[18] Zhao, G.; Huang, X.; Taini, M.; Li, S.Z.; Pietikäinen, M. Facial expression recognition from near-infrared videos. Image Vision Comput. 2011

[19] Thorat, Bali, Ganesh Manza, and Pravin Yannawar. "Automatic Classification of Facial Expressions from Video Stream using Decision Tree." International Journal of Computer Applications 121.22 (2015).

[20] A Study of Techniques for Facial Detection and Expression Classification

[21] A Hybrid Approach of Facial Emotion Detection using Genetic Algorithm along with Artificial Neural Network

[22] Sandeep K. Gupta, ShubhLakshmi Agrwal, Yogesh K. Meena, Neeta Nain "A Hybrid Method of Feature Extraction for Facial Expression Recognition" 2011 Seventh International Conference on Signal Image Technology & Internet-Based Systems.

[23] Ziyang Zhang, Xiaomin Mu, Lei Gao " Recognizing Facial Expressions Based on Gabor Filter Selection" 2011 4th International Congress on Image and Signal Processing.

[24] Gudi, Amogh, et al. "Deep learning based facs action unit occurrence and intensity estimation." Automatic Face and Gesture Recognition (FG), 2015 11th IEEE International Conference and Workshops on. Vol. 6. IEEE, 2015.

[25] McDuff, Daniel, et al. "AFFDEX SDK: a cross-platform real-time multi-face expression recognition toolkit." Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems. ACM, 2016.

[26] Jeffreys, Alec J., Victoria Wilson, and Swee Lay Thein. "Hypervariable 'minisatellite' regions in human DNA." Nature 314, no. 6006, pp. 67-73, 1985.

[27] Peter Gill, Alec J. Jeffreys & David j. Werrett, "Forensic application of DNA 'fingerprints'", Nature 318, pp. 577 – 579, December 1985.

[28] Lajevardi, Seyed Mehdi, and Margaret Lech. " Facial expression recognition using neural networks and log-gabor filters." In Computing: Techniques and Applications, 2008. DICTA'08. Digital Image, pp. 77-83. IEEE, 2008.

[29] Nectarios Rose," Facial Expression Classification using Gabor and Log-Gabor Filters", IEEE 7 th International Conference on Automatic Face and Gesture Recognition, 2006.

[30] Sanchez-Mendoza, David, David Masip, and Agata Lapedriza. " Emotion recognition from mid-level features." Pattern Recognition Letters 67, pp. 66-74,2015.