Decision Based Adaptive Median Filter Used For Noise Removal From Images using LBP Technique

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Abstract – LBP is really a very powerful method to explain the texture and model of a digital image. Therefore it was ideal for feature extraction in face recognition systems. A face image is first split into small regions that LBP histograms are extracted and then concatenated in to a single feature vector. This vector forms an efficient representation of the face area and can be used to measure similarities between images. Automatic facial expression analysis is a fascinating and challenging problem, and impacts important applications in several areas such as human computer interaction and data-driven animation. Deriving a facial representation from original face images is an essential step for successful facial expression recognition method. In this paper, we evaluate facial representation predicated on statistical local features, Local Binary Patterns, for facial expression recognition. Various machine learning methods are systematically examined on several databases. Broad experiments illustrate that LBP features are effective and efficient for facial expression recognition. Experiment Analysis of the Local Binary Pattern i.e. how the test images are matched with the training images although determine the minimum ecludian distance for which the images are match according to the features that are extracted in feature extraction phase and then evaluate the recognition rates using Local Binary Pattern Approach. In the next phase the noise is added into the images database, with the affect of noise the LBP gives the minimum recognition rates; therefore to enhance the recognition rates up to the maximum rates that the LBP provides in the first phase i.e. the LBP is Hybrid with the latest filter DBAMF (Decision Based Adaptive Median Filter). This Hybrid method gives the better recognition rates i.e. the enhancement in the accuracy of the LBP. Mainly to design a Hybrid Approach for the process of Face recognition of the images using the LBP Approach with Decision Based Median Filter. Because existence of the noise in the images will leads to less efficient results, therefore is essential to remove the noise from the images that are stored in to the databases for the Face Recognition Process.

Keywords: Local binary pattern, face recognition, decision based adaptive median filter, histogram matching, histogram equalization, noise removal, and feature extraction.

I. INTRODUCTION

Face recognition is a dynamic research region, and they can be utilized in wide variety of applications such as surveillance and safety. Face is a complicated multidimensional structure and desires a good computing method for recognition. Face recognition system can be utilized in two modes: Verification and Identification. Facial feature extraction includes localizing almost certainly the most characteristics features of the face image like eyes, nose and mouth feature regions. Face recognition technology is the least disturbing and greatest biometric technology. It mechanism with the mainly clear individual identifier the human face. As an alternative of require people to place their hand on a reader (a process not adequate in some cultures as well as being a basis of illness transfer) or exactly position their eye in front of a scanner, face recognition systems discreetly take pictures of people's faces as they enter a distinct area. There is no disturbance or delay, and in most cases the subjects are exclusively unaware of the process. They do not feel "under surveillance" or that their isolation has been invaded.

Face identification analyzes the description of individuals face images input through a digital video camera. It processes the usually facial composition, as well as distance among eyes, nose, mouth, and jaw edges. These dimensions are retained in a database and utilize as an evaluation when a user rise previous to the camera.

How it Works

The subsequent four phase process illustrates the method biometric system work:

Capture - an objects or behavioral illustration is capture by the method right through staffing.

Extraction - characteristic information is taken out from picture and a pattern is produced.

Comparison - the pattern is afterwards comparing with a novel illustration.

Matching - the process then make a decision if the description take out from the new section are identical or not.

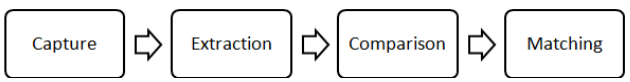


Fig. 1. Face Extraction

1.1 Histogram Equalization

It is usually done on low contrast images in order to enhance image quality and to improve face recognition performance. It changes the dynamic range (contrast range) of the image and as a result, some important facial features are more visible. Mathematically histogram equalization may be expressed as:

$$S_k = T(r_k) = \Sigma_{j=0}^{k} \frac{n_j}{n}$$

Where k=0, 1, 2….L-1

'n' is the total number of pixels in an image, 'nj' is the number of pixels with gray level 'rk', and 'L' is the total number of gray levels exists in the face image. The result after applying histogram equalization to a sample face image is shown in Figure.

a) Original image b) Histogram Equalized image

Fig. 2. Histogram Equalization

The histogram on the left is of the original face image and the one on the right is after the histogram equalization method is applied.

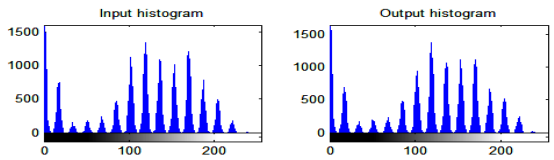


Fig. 3. Histogram Matching

REVIEW OF EXISTING METHDOLOGY

The LBP test the association between pixel and its neighbors, programming that association exact into a binary word. This permit identification of patterns/features, while individual protected to difference changes. LBP discuss points adjacent a main point and tests possibly the adjacent points are superior than or less compare to key face (i.e. provide a binary outcome).

Algorithm

We start by summarizing the main common steps of the algorithms used in this work. he proposed face recognition process consists of four main parts:

1) Preprocessing: We begin by applying the Tan and Triggs' illumination normalization algorithm to compensate for illumination variation in the face image. No further preprocessing, such as for example face alignment, is performed in the preprocessing.

*2) LBP operator applicat***ion:** In the 2nd stage LBP are computed for each pixel, making a fine scale textural description of the image.

3) Local feature extraction process: Local features are produced by computing histograms of LBP over local image regions.

4) Classification: Each face image in test set is classified by comparing it against the face images in the training set. The comparison is performed using the local features obtained in the previous step in the algorithm.

To implement the face recognition in this research work, we proposed the Local Binary patterns methodology. Local Binary Pattern works on local features that uses LBP operator which summarizes the local special structure of a face image.

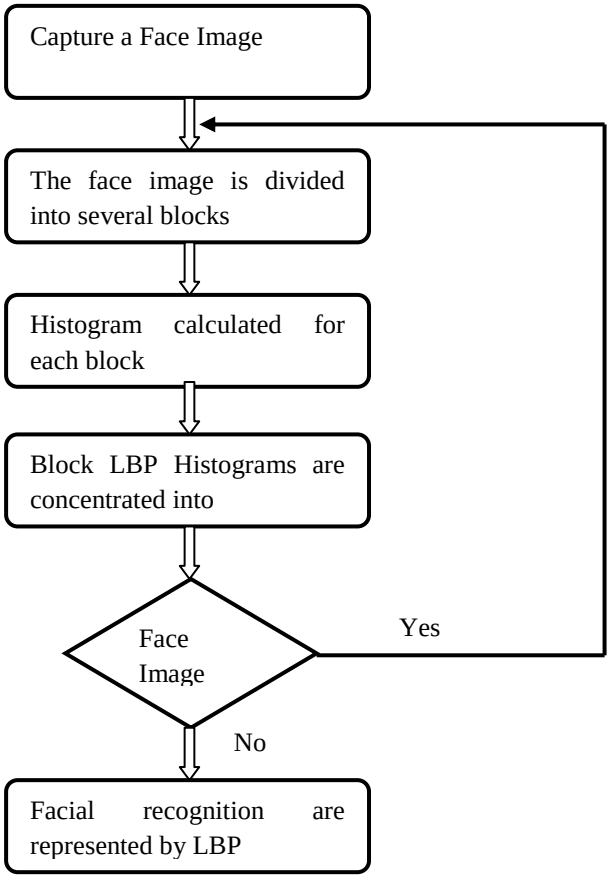


Fig. 4. Flow Chart of LBP

II. PROPOSED METHODOLOGY

Experiment Analysis of the *Local Binary Pattern* i.e. how the test images are matched with the training images although determine the minimum ecludian distance for which the images are match according to the features that are extracted in feature extraction phase and then evaluate the recognition rates using *Local Binary Pattern* Approach. In the next phase the noise is added into the images database, with the affect of noise the LBP gives

the minimum recognition rates, therefore to enhances the recognition rates up to the maximum rates that the LBP provides in the first phase i.e. the LBP is Hybrid with the latest filter DBAMF (Decision Based Adaptive Median Filter). This Hybrid method gives the better recognition rates i.e. the enhancement in the accuracy of the LBP. Mainly to design a Hybrid Approach for the process of *Face recognition* of the images using the LBP Approach with Decision Based Adaptive Median Filter.

The graphical representation for the Hybrid Approach is discussed later on.

3.1 Outline of Proposed Methodology

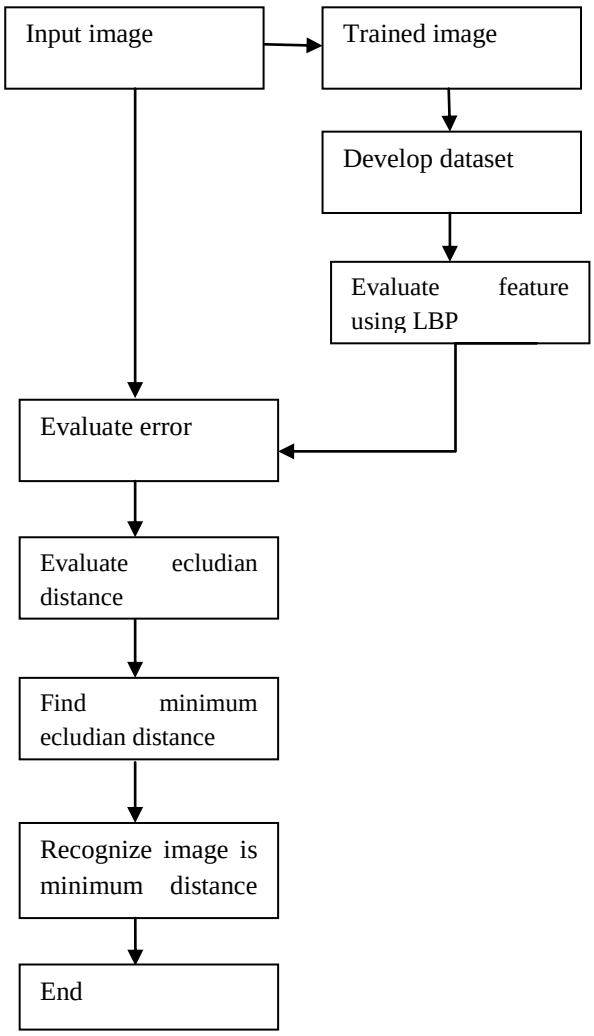


Fig. 5. LBP Method

Input:

(i) A set of face images considered as training set

(ii) Another face image considered as a test image

Process Details:

(1) Pre-processing module:

(i) Face Image Acquisition

(2) Feature Extraction Module:

(3)Recognition Module:

*Flow chart of the Recognition Module for the Face Images***:** This Flow chart describes the overall processing of the face recognition process (i.e. face images matching) according to which phase the images is recognized as a face images or not.

The LBP test the association between pixel and its neighbors, programming that association exact into a binary word. This permit identification of patterns/features, while individual protected to difference changes.

3.2 Decision Based Adaptive Median Filtering

Noise is an unwanted invention of image. The digital image acquirement process convert a visual image occupied with an optical device into a continuous stream of electrical signals that is later sampled in the main process by which noise appear in digital images. Salt and Pepper noise is a particular case of Impulse noise where a fraction of pixels in an image is distorted either in to the least or peak intensity (0 or 255). It is normally cause by not working of camera sensors, defective memory locations in hardware or communication in a noisy channel. Salt and Pepper is a category of noise that is normally there in images throughout image acquirement. It has unwanted collision on digital images; consequently it is compulsory to remove them before the noise infected image is used in a variety of image processing applications. For that reason, many filtering techniques were projected for the re-establishment or restoration reason to eliminate Salt and Pepper type noise. The Standard Median Filter (SMF) method was once one of the most extensively used non-linear noise filtering approaches to eliminate this noise, largely due to its denoising ability and computational efficiency. On the other hand, when the noise level is as high as 50%, it fails to conserve particulars and edges of the image. A numeral of improved methods such as Adaptive Median Filter (AMF) method and Weighted Median Filter (WMF) method has been projected to conquer this problem. These filters windows contain a set of number and recognize likely noisy pixels and then restore them by means of the median filter or its variants, while separation all the other pixels unaffected. The ordinary disadvantage among all of this filtering technique is that the noisy pixels are replace without taking into description local features such as the presence of edges. Therefore details of the images and edges are not improved adequately, particularly when the noise level is high.

3.4 Decision Based Adaptive Median Filtering Method to Remove Salt and Pepper Noise in Digital Images for the Face Recognition

The Adaptive Median Filter performs processing to find out which pixels in an image include noise. It classify pixels as noise by compare every pixel in the image to its neighboring pixels. A pixel that is dissimilar from a bulk of its neighbors, as well as being not structurally associated with those pixels to which it is like, is chosen as impulse noise. These noisy pixels are then replaced by the average (median) value of the pixels in the area that have passed the noise recognition test.

3.3 Hybrid Approach

LBP is Hybrid with the latest filter DBAMF (Decision Based Adaptive Median Filter). This Hybrid method gives the better recognition rates i.e. the enhancement in the accuracy of the LBP. Mainly to design a Hybrid Approach for the process of *Face recognition* of the images using the LBP Approach with Decision Based Adaptive Median Filter.

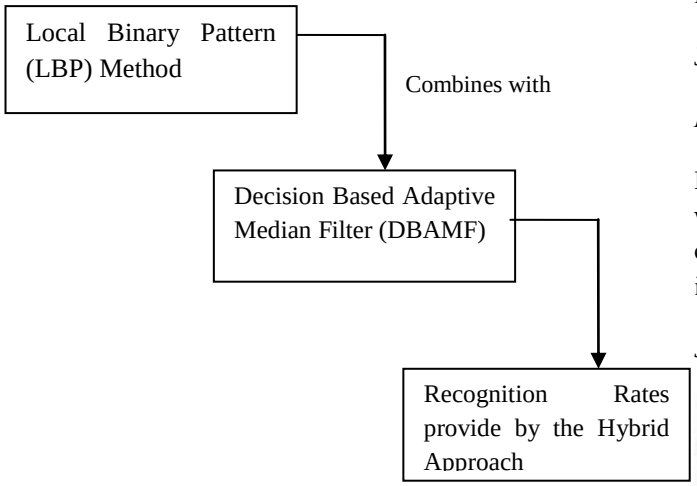


Fig. 6. Hybrid with DBAMF

III. EXPERIMENTAL EVALUATION

In evaluation, the first phase to check the performance of Local Binary Pattern Method i.e. to ensure that the result provided by this technique is acceptable or not, mainly check the recognition rates or the accuracy rates of the images (i.e. images are taken from the Real Dataset and JAFFE Dataset) in the Face identification process.

In the Second Phase, usually to compare the results on the Real Dataset and the Standard JAFFE Dataset using the Local Binary Pattern Technique.

In the Third Phase, the Hybrid Approach is developed to remove the noise from the images, because noise is the parameter which ensures the regulation of the images. Therefore the noise must be eliminated from the images to regulate the proper image for the integrity of the database images. The removal of noise from the images is done with the help of latest new filter i.e. Decision Based Adaptive Median Filter, (which is explained in the later on section). The different values of noise is considering for the evaluation of this method. Basically to design a proposed method to remove the noise from the images to perform better when the images are taken from the sources, this interrupts the originality of the face images. Therefore to ensure the originality of the face images for the various purposes i.e. surveillance.

In the method, the two datasets are taken for the process of recognition i.e. Standard JAFFE Dataset and the Real Dataset. The Standard JAFFE Dataset contains the 213 face images according to the various poses made by the images.

Image Databases

In the Experimental Evaluation phase, i have compared the recognition rates of Standard dataset JAFFE (Japanese Female Facial Expressions) with the Real Dataset.

JAFFE (Japanese Female Facial Expressions) Dataset

Real Dataset

In Real Dataset i have collect some picture for my work in which the Local Binary Pattern Method is applied to compare the results of both the Databases. Below the images in the Dataset are shown:

JAFFE (Japanese Female Facial Expressions) Dataset:

Fig. 7. JAFFE training dataset

The training database containing the two or more images of different personalities.

Fig. 8. JAFFE test dataset

This is the test dataset containing the different sample images that will be used for matching purposes.

Real Dataset:

Fig. 9. Real Training Dataset (.jpg images)

The training database containing the two or more images of different personalities.

Fig. 10. Real Test dataset (.jpg images)

This is the test dataset containing the different sample images that will be used for matching purposes.

Local Binary Pattern method is applied on the standard JAFFE dataset and gives the following results:

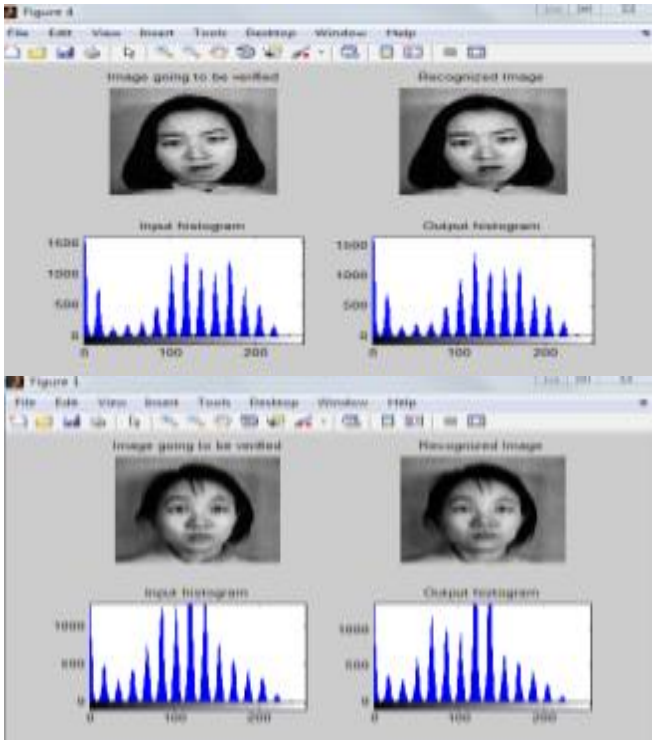


Fig. 11. Standard JAFFE Dataset images recognition process and their Histograms

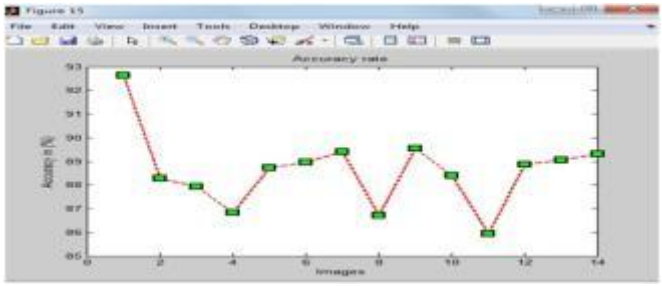


Fig. 12. Accuracy graph of images of JAFFE Dataset during Recognition Process

This Accuracy graphs shows the accuracy rates of images which are recognized during the process of Face Recognition. The Local Binary Pattern (LBP) is used for this purpose to obtain the results. The green colour rectangle boxes shows the accuracy rates of the face images.

Results on Standard JAFFE Dataset

TABLE 1. Results of Accuracy rates on Standard JAFFE Dataset

Accuracy Rates	**Images are Recognized in the data base**
0.9264	Recognized image name in data base - 184.jpg
0.8829	Recognized image name in data base - 63.jpg
0.8794	Recognized image name in data base - 63.jpg
0.8683	Recognized image name in data base - 150.jpg
0.8873	Recognized image name in data base - 57.jpg
0.8897	Recognized image name in data base - 61.jpg
0.8941	Recognized image name in data base - 57.jpg
0.8673	Recognized image name in data base - 160.jpg
0.8954	Recognized image name in data base - 48.jpg
0.8841	Recognized image name in data base - 48.jpg
0.8595	Recognized image name in data base - 151.jpg
0.8888	Recognized image name in data base - 57.jpg
0.8907	Recognized image name in data base - 57.jpg
0.8933	Recognized image name in data base - 53.jpg

Local Binary Pattern method is applied on the Real dataset and gives the following results

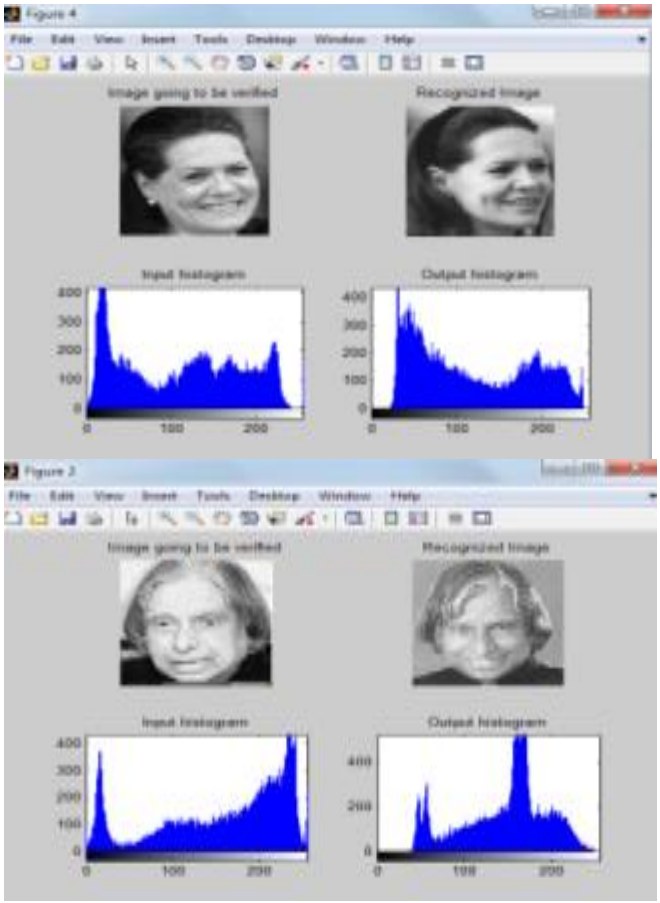


Fig. 13. Real Dataset images recognition process and their Histograms

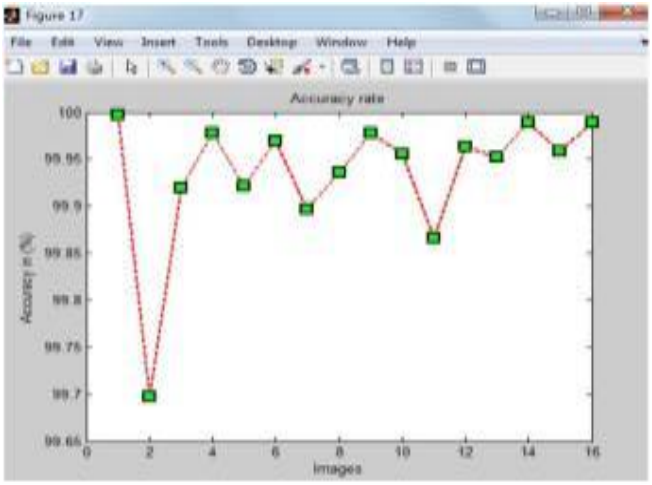


Fig. 14. Accuracy graph of Face images of Real Dataset during Recognition Process

This Accuracy graphs shows the accuracy rates of images which are recognized during the process of Face Recognition. The Local Binary Pattern (LBP) is used for this purpose to obtain the results. The green colour rectangle boxes shows the accuracy rates of the face images.

Results on Real Dataset

TABLE 2. Results of Accuracy rates on Real Dataset

Accuracy Rates	**Images are Recognized in the data base**
1.0000	Recognized image name in data base - 22.jpg
0.9970	Recognized image name in data base - 25.jpg
0.9992	Recognized image name in data base - 32.jpg
0.9998	Recognized image name in data base - 29.jpg
0.9992	Recognized image name in data base - 9.jpg
0.9997	Recognized image name in data base - 11.jpg
0.9990	Recognized image name in data base - 14.jpg
0.9994	Recognized image name in data base - 15.jpg
0.9998	Recognized image name in data base - 17.jpg
0.9996	Recognized image name in data base - 19.jpg
0.9987	Recognized image name in data base - 1.jpg
0.9996	Recognized image name in data base - 3.jpg
0.9995	Recognized image name in data base - 7.jpg
0.9999	Recognized image name in data base - 35.jpg
0.9996	Recognized image name in data base - 33.jpg
1.0000	Recognized image name in data base - 41.jpg

TABLE 3. Shows the Comparison of the rates on the Standard Dataset and Real Dataset

Accuracy on Standard Dataset	**Accuracy on Real Dataset**
0.9264	1.0000
0.8829	0.9970
0.8794	0.9992
0.8683	0.9998
0.8873	0.9992
0.8897	0.9997
0.8941	0.9990
0.8673	0.9994
0.8954	0.9998
0.8841	0.9996
0.8595	0.9987
0.8888	0.9996
0.8907	0.9995
0.8933	0.9999

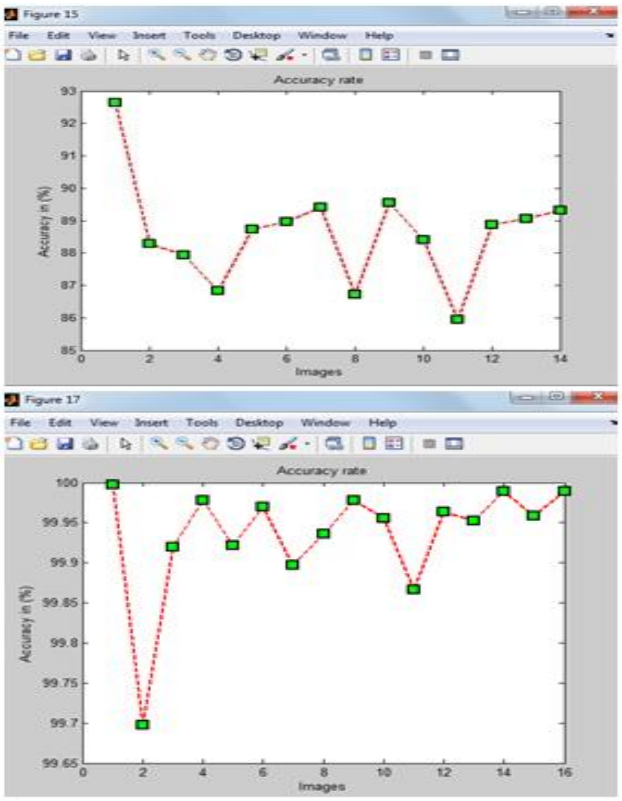


Fig. 15. Accuracy rates on the Standard Dataset and on the Real Dataset

The First graph shows the accuracy rates on the Standard JAFFE Dataset and the Second graph shows the accuracy rates on the Real Dataset, it is clearly shown that the results obtained are on the Real Dataset are good as compared with the results obtained on the Standard JAFFE Dataset. Therefore this method represents the face image recognition not only to frontal faces but also on the variant faces.

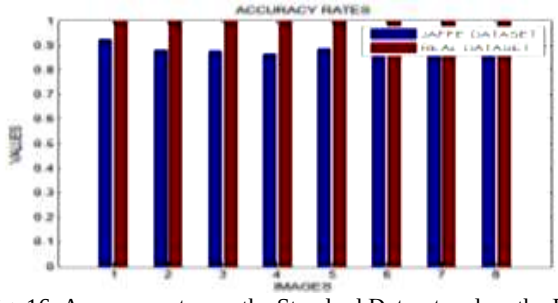


Fig. 16. Accuracy rates on the Standard Dataset and on the Real Dataset

Effect of Noise on Local Binary Pattern

In this module, i have the taken the different noise ratio according to the requirement. Basically to determine the effect of noise on the Local Binary Pattern (LBP).

Because existence of the noise into the images is very crucial while maintaining the database i.e. while collecting the images from the cameras or some others types of sort mainly the called the image acquiring or the image acquisition process. Therefore is essential to remove the noise from the images that are stored in to the databases.

In this module i have taken the several value of noise parameter which is added into the images likely 0.6, 0.7, 0.8 values (i.e. the percentage of noise) which is added into the images. Therefore for the addition of noise the Local binary Pattern (LBP) evaluate the recognition rates or Accuracy rates for the different aspect of the noise values into the images. Due to the addition of noise into the images reduces the face recognition values or the accuracy rates values this is the general thing, therefore our objective is to eliminates the noise and enhances the recognition rates i.e. reaches to the maximum value of recognition which the Local Binary Pattern (LBP) gives into the his first phase of recognition.

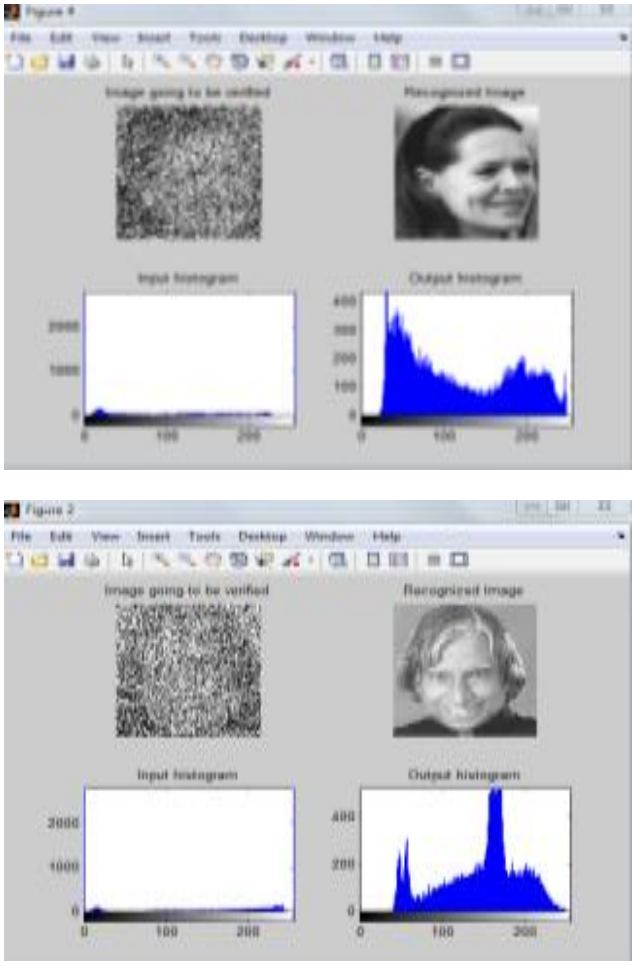


Fig. 17. Effect of noise on Real Dataset image and generation of their Histograms

TABLE 4. Shows the effect of noise on Accuracy rates

(0.6)	(0.7)	(0.8)	Recognized Images in data base
0.6977	0.6523	0.5994	Recognized image name in data base - 22.jpg
0.6982	0.6478	0.5950	Recognized image name in data base - 25.jpg

0.7036	0.6525	0.6003	Recognized image name in data base - 32.jpg
0.7002	0.6502	0.6011	Recognized image name in data base - 29.jpg
0.7006	0.6496	0.5969	Recognized image name in data base - 9.jpg
0.6954	0.6465	0.5985	Recognized image name in data base - 11.jpg
0.7020	0.6478	0.6019	Recognized image name in data base - 14.jpg
0.7019	0.6501	0.6026	Recognized image name in data base - 15.jpg
0.6996	0.6502	0.5988	Recognized image name in data base - 17.jpg
0.7032	0.6469	0.5947	Recognized image name in data base - 19.jpg
0.6954	0.6480	0.5978	Recognized image name in data base - 1.jpg
0.6994	0.6511	0.5975	Recognized image name in data base - 3.jpg
0.6941	0.6515	0.5931	Recognized image name in data base - 7.jpg
0.7004	0.6508	0.6012	Recognized image name in data base - 35.jpg
0.7019	0.6481	0.5983	Recognized image name in data base - 33.jpg
0.6979	0.6474	0.5961	Recognized image name in data base - 41.jpg

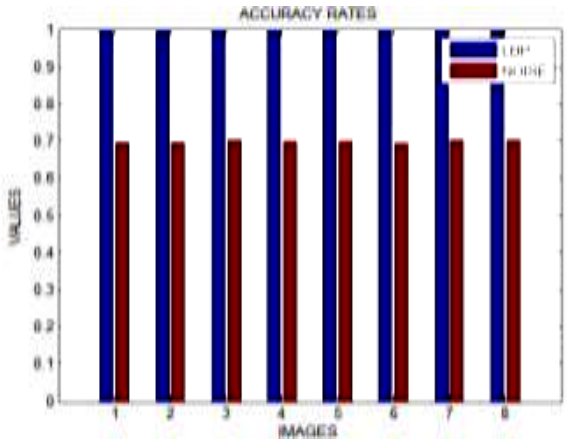


Fig. 18. Effect of noise on Real Dataset

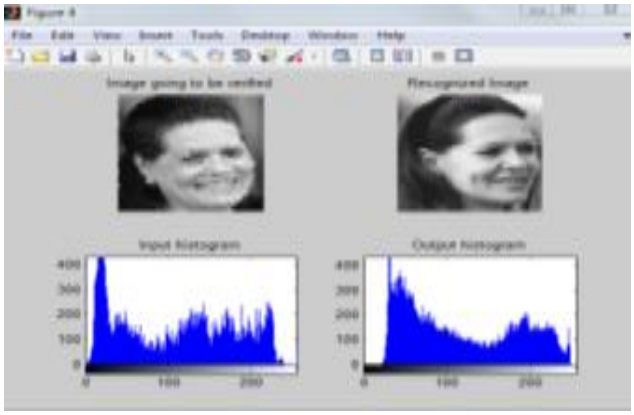
The Hybrid Face Recognition Algorithm Using Local Binary Pattern Method and Decision Based Adaptive Median Filter (DBAMF)

With the use of Decision Based Adaptive Median Filter on the Local Binary Pattern to evaluate the effect of noise on this technique and also to evaluate the recognition rates on the Real dataset using the Hybrid method of Local Binary Pattern with Decision Based Adaptive Median Filter and clearly shown that in the following figures that the recognition rates reaches to the maximum recognition rates which will give in the first module of the Local Binary Pattern recognition

To remove Noise with the Use of the Decision Based Adaptive Median filter

TABLE 5. Accuracy rates after Filtering Process

Accuracy Rates	**Images are Recognized in the data base**
0.9994	Recognized image name in data base - 22.jpg
0.9993	Recognized image name in data base - 25.jpg
0.9991	Recognized image name in data base - 32.jpg
0.9999	Recognized image name in data base - 29.jpg
0.9980	Recognized image name in data base - 9.jpg
0.9989	Recognized image name in data base - 11.jpg
0.9987	Recognized image name in data base - 14.jpg
0.9990	Recognized image name in data base - 15.jpg
0.9998	Recognized image name in data base - 17.jpg
0.9990	Recognized image name in data base - 19.jpg
0.9986	Recognized image name in data base - 1.jpg
0.9990	Recognized image name in data base - 3.jpg
0.9986	Recognized image name in data base - 7.jpg
0.9994	Recognized image name in data base - 35.jpg
0.9992	Recognized image name in data base - 33.jpg
0.9989	Recognized image name in data base - 41.jpg



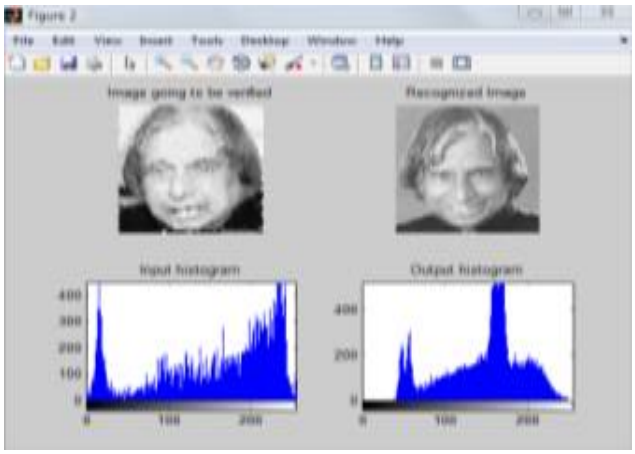


Fig. 19. Recognized images with their equalized Histograms

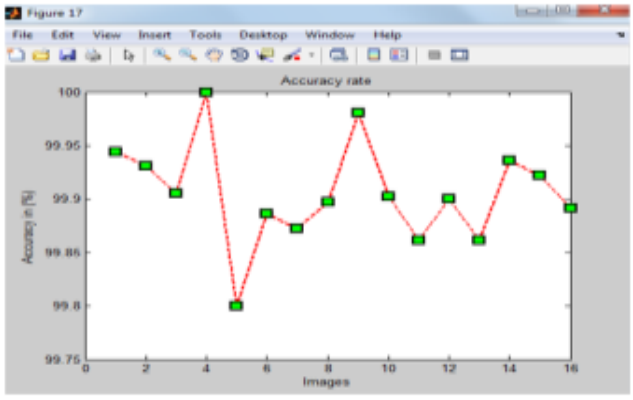


Fig. 20. Accuracy Rates graph for the Decision Based Adaptive Median Filter

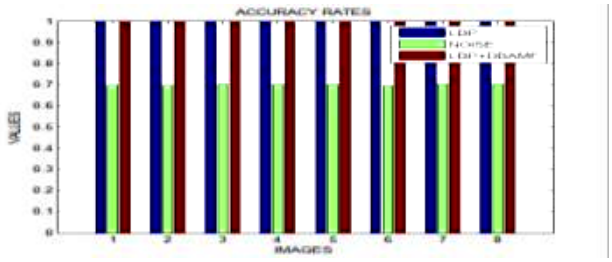


Fig. 21. The result after Filtering reaches to the maximum Accuracy Rates

The blue line shows the accuracy results on the Real Dataset after the Filtering Process to ensure the maximum accuracy rates up to that extent in which the Local Binary Pattern Method (Red Line) gives on the Real Dataset before the Filtering Process that results are shown in the second graph i.e. to remove the salt and pepper noise from the face images during the Face Recognition process.

IV. CONCLUSION AND FUTURE SCOPE

The research work has to be done on the performance of a face recognition method by construct a use of feature extraction process with Local Binary Patterns Method. It essentially consists of three parts, namely face illustration, feature extraction and categorization. Face demonstration represents how to represent a face and determine the consecutive algorithms of face recognition. The generally constructive and exclusive features of the face image are extracted in the feature extraction phase. In the categorization the face image is compared among the images from the different dataset. This technique represents the local feature of the face and matches it with the generally similar face image in dataset. The accurateness of the classification is approximately equals to 100% by the Local Binary Patterns Method.

The overall review of the Local Binary Pattern is to check the performance of face recognition of the face images which are taken from the various databases and also compare the accuracy or recognition rates to determine the performance evaluation of this technique. The Local Binary Pattern is then Hybrid with Filtering technique i.e. Decision Based Median Filter to reduce to impact of noise on the images that is to ensure that Local Binary Pattern Method Works under the ir-regular conditions and gives the performance according to the critical situation. The work is to done on the hybrid method and to raise the performance of Local Binary Pattern in terms of recognition rates further the work constitutes upon the other updations which will leads to improve the efficiency of Local Binary Pattern method.

The LBP takes very less time for the computation of the particular task because it is very easy, simple method and robust against the illumination changes, aging of the persons.

V. FUTURE SCOPE

It is observable so as to the consequence of this face recognition method is superior but there is extent for future enhancement. The main enhancement will pursue the performances, recognizes the real-time face recognition. I would like to enhance my code for face image recognition or identification as well as clean up the code in order to enhance the performance. Different Input face Images has been faced difficulty when identified a face images from dataset such as pose and illumination variations and face occlusions. In future to enhance the results of this Local Binary Pattern Method which is combine with the other face recognition technique in order to improve the performance of recognition i.e. provide good consequences in the illumination changes and the aging of the persons.

REFERENCES

[1] Matti Pietikäinen “Image Analysis with Local Binary Patterns” *Machine Vision Group, H. Kalviainen et al.* (Eds.): SCIA 2005, LNCS 3540, pp. 115 – 118, 2005.

[2] Timo Ahonen, Abdenour Hadid, and Matti Pietik¨ainen “Face Recognition with Local Binary Patterns “*T. Pajdla and J. Matas (Eds.):* ECCV 2004, LNCS 3021, pp. 469–481, 2004.

[3] S´ebastien Marcel, Yann Rodriguez and Guillaume Heusch “On the Recent Use of Local Binary Patterns for Face Authentication” *International Journal of Image and Video*

processing, Special Issue on Facial Image Processing (2007).

[4] Ekenel, Hazim K., Mika Fischer, Erkin Tekeli, Rainer Stiefelhagen, and Aytil Ercil. "Local binary pattern domain local appearance faces recognition." In *Signal Processing, Communication and Applications Conference, 2008. SIU 2008. IEEE* vol. no. *16th*, pp. 1-4. IEEE, 2008.

[5] Xu, Xian-chuan, and Qi Zhang. "Medical image retrieval using local binary patterns with image euclidean distance" In *International Conference on Information Engineering and Computer Science* pp. 1–4. 2009.

[6] Zhang, Baochang, Yongsheng Gao, Sanqiang Zhao, and Jianzhuang Liu. "Local derivative pattern versus local binary pattern: face recognition with high-order local pattern descriptor." *Image Processing, IEEE Transactions on* 19, vol no. 2 pp.533-544 (2010).

[7] Tian, Hongda, Wanqing Li, Philip Ogunbona, Duc Thanh Nguyen, and Ce Zhan. "Smoke detection in videos using non-redundant local binary pattern-based features." In *Multimedia Signal Processing (MMSP), 2011 IEEE 13th International Workshop on*, pp. 1-4. IEEE, 2011.

[8] Meena, K., and A. Suruliandi. "Performance evaluation of Local Binary Patterns and its derivatives for face recognition." In *Emerging Trends in Electrical and Computer Technology (ICETECT), 2011 International Conference on*, pp. 742-746. IEEE, 2011.

[9] Nguyen, Due Thanh, Philip Ogunbona, and Wanqing Li. "Human detection with contour-based local motion binary patterns." In *Image Processing (ICIP), 2011 18th IEEE International Conference on*, pp. 3609-3612. IEEE, 2011.

[10] Ma, Yan. "Number local binary pattern: An extended local binary pattern." In *Wavelet Analysis and Pattern Recognition (ICWAPR), 2011 International Conference on*, pp. 272-275. IEEE, 2011.

[11] Singh, Suryakant, Ritesh Maurya, and Ajay Mittal. "Application of Complete Local Binary Pattern Method for facial expression recognition." In *Intelligent Human Computer Interaction (IHCI), 2012 4th International Conference on*, pp. 1-4. IEEE, 2012.

[12] Li, Zhi, Guizhong Liu, Yang, and Junyong You. "Scale- and rotation-invariant local binary pattern using scale-adaptive texton and subuniform-based circular shift." *Image Processing, IEEE Transactions on* 21, vol no. 4 (2012) pp 2130-2140.

[13] Loris Nanni, SherylBrahnam, AlessandraLumini "A simple method for improving local binary patterns by considering non-uniform patterns" *Pattern Recognition* 45 (2012) pp. 3844–3852.

[14] Hengliang Tang, BaocaiYin, YanfengSun, YongliHu "3D face recognition using local binary patterns" Signal Processing vol no 93 (2012) pp. 2190–2198.

[15] Li Liu, Lingjun Zhao, Yunli Long, Gangyao Kuang, Paul Fieguth "Extended local binary patterns for texture classification" Image and Vision Computing vol no 30 (2012) pp. 86–99.

[16] Chetan Ballur, Shylaja S S "Application of Local Binary Pattern and Principal Component Analysis For Face Recognition*" International Journal of Electrical, Electronics and Data Communication*, ISSN (pp): 2320-2084, Vol no12013.

[17] Di Huang, Caifeng Shan, Mohsen Ardebilian, Yunhong Wang, and Liming Chen "Local Binary Patterns and Its Application to Facial Image Analysis: A Survey" *IEEE Transactions On Systems, Man, And Cybernetics—Part C: Applications And Reviews*, vol. no. 6, November 2013.

[18] Satpathy, Amit, Xudong Jiang, and How-Lung Eng. "Human detection using discriminative and robust local binary pattern." In *Acoustics, Speech and Signal Processing (ICASSP), 2013 IEEE International Conference on*, pp. 2376-2380. IEEE, 2013.

[19] Suruliandi, A., K. Meena, and R. Reena Rose. "Local binary pattern and its derivatives for face recognition." *Computer Vision, IET* 6, vol no. 5 (2013) 480-488.

[20] Lu, Yu, Shan Juan Xie, Sook Yoon, and Dong Sun Park. "Finger vein identification using polydirectional local line binary pattern." In *ICT Convergence (ICTC), 2013 International Conference on*, pp. 61-65. IEEE, 2013.

[21] Md. Abdur Rahim, Md. Najmul Hossain, Tanzillah Wahid & Md. Shafiul Azam "Face Recognition using Local Binary Patterns (LBP) " *Global Journal of Computer Science and Technology Graphics & Vision* vol no 13 2013 Online ISSN: 0975-4172 & Print ISSN: 0975-4350.

[22] Bo Yang, SongcanChen," A comparative study on local binary pattern (LBP) based face recognition: LBP histogram versus LBP image" Neuro Computing vol no 120 (2013) pp.365–379.

[23] Shekar, B. H., and Bharathi Pilar. "Shape Representation and Classification through Pattern Spectrum and Local Binary Pattern--A Decision Level Fusion Approach." In *Signal and Image Processing (ICSIP), 2014 Fifth International Conference on*, pp. 218-224. IEEE, 2014.

[24] Davarzani, Reza, and Saeed Mozaffari. "Robust Image Description with Weighted and Adaptive Local Binary Pattern Features." In *Pattern Recognition (ICPR), 2014 22nd International Conference on*, pp. 1097-1102. IEEE, 2014.

[25] Yuan, Jing-Hua, De-Shuang Huang, Hao-Dong Zhu, and Yong Gan. "Completed hybrid local binary pattern for texture classification." In *Neural Networks (IJCNN), 2014 International Joint Conference on*, pp. 2050-2057. IEEE, 2014.

[26] Apeksha Nachone, Prof. Karuna G. Bagde "Facial Expression Recognition" *et al*, *International Journal of Computer Science and Mobile Computing*, Vol.4 Issue.1, January- 2015, pp. 398-402.

[27] Wang, Xianji, Haifeng Gong, Hao Zhang, Bin Li, and Zhenquan Zhuang. "Palmprint identification using boosting local binary pattern." In *Pattern Recognition, 2006. ICPR 2006. 18th International Conference on*, vol. 3, pp. 503-506. IEEE, 2006.

[28] Su, Song-Zhi, Shao ZiLi, Shu-Yuan Chen, Shang-An Li, and Der-Jyh Duh. "Structured Local Binary Haar pattern for graphics retrieval." In *2010 IEEE International Conference on Intelligent Computing and Intelligent Systems*, vol. 2, pp. 670-674. 2010.

[29] Meena, K., and A. Suruliandi. "Local binary patterns and its variants for face recognition." In *Recent Trends in Information Technology (ICRTIT), 2011 International Conference on*, pp. 782-786. IEEE, 2011.

[30] Sun, Junding, Guoliang Fan, and Xiaosheng Wu. "New local edge binary patterns for image retrieval." In *ICIP*, pp. 4014-4018. 2013.

[31] Hazım K. Ekenel, Mika Fischer, Erkin Tekeli, Rainer Stiefelhagen, Aytul Ercil "Local Binary Pattern Domain Local Appearance Face Recognition" 978-1-4244-1999-9/08/$25.00 ©2008 IEEE.

[32] Claude C. Chibelushi, Fabrice Bourel "Facial Expression Recognition: A Brief Tutorial Overview", *School of Computing, Staffordshire university*, 2002.

[33] Caifeng Shan a, Shaogang Gong, Peter W. McOwan "Facial expression recognition based on Local Binary Patterns: A comprehensive study*" Image and Vision Computing* vol no 27 (2009) pp. 803–816.

[34] AnaghaV.Malkapurkar, Rupali Patil, Prof. Sachin Murarka, " A New Technique for LBP Method to Improve Face Recognition" International Journal of Emerging Technology and Advanced Engineering ISSN 2250-2459, vol no1, Issue 1, November 2011.

[35] Ahonen, T., Hadid, A., Pietikäinen and M.:" Face Recognition with Local Binary Patterns" In: Computer Vision, ECCV 2004 Proceedings, Lecture Notes in Computer Science 3021 (2004) pp. 469-481.

[36] C. Shan, S. Gong, P.W. McOwan," Robust facial expression recognition using local binary patterns", in: IEEE International Conference on Image Processing (ICIP), Genoa, vol. no 2, 2005, pp. 370–373.