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Elimination of Angular Problem in Face Recognition

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Abstract **-- Face Recognition is considered to be the most suitable technique for the real-time application. This technique is commonly used for the security purposes of authentication in computerized fields. Previously various algorithms and techniques were used for the purpose of security and authentication, but they were having several pitfalls like time consumption, pose and illumination problem along with age differences. Keeping these things in mind along with the available literature review a hybrid technique for face recognition is proposed in this work. In the proposed method, face recognition is done by combining two most commonly used techniques and making it hybrid in nature which would combine their advantages and reduce the false matching rate along with fast key generation time.**

Keywords -- Facial image representation, LBP, PCA, Recognition rate, False match rate, Key Generation, Encryption, Decryption

I. INTRODUCTION

The Face recognition is most acceptable biometrics technique. The problem of other authentication system like fingerprint, voice, iris have problem of data acquisition. Over the last three decades, face recognition technique studied by several authors. The greatest progress has been achieved towards developing computer vision algorithms that can recognize individuals based on their facial images in a same way as human do. It can be possible due to the reason of increasing of computational power. Face recognition is still remaining an open challenge and major problem to be solved. The automated recognition system is becoming more popular when compared with other biometrics systems. Face recognition system does not require high accuracy and expensive image acquisition equipments. It has non-contact measurement.

II. FACE RECOGNITION PROBLEM USING PCA ALGORITHM

- Illumination Problem
  Illumination problem happens when same image with condition. So person have to keep with fix lighting condition, fixed distance, same facial

expression and also same view point. It can emerge extensively different when lighting condition is different [8].

- Pose Problem
  Face recognition with different facial poses that is called pose problem. If face rotation made very large changes in face appearance it reduce recognition rate. If person try to match same image with different facial pose, it show the different result [8].

III. Face Recognition Problem using LBP Operator

Limitation of the basic LBP operator is that its small 3 * 3 neighborhood cannot capture dominant features with large-scale structures. It cannot deal with the texture at different scales and the operator was later generalized to use neighborhoods of different size so LBP cannot work well on large scale images [5].

IV. DATABASE

The FEI face database is a Brazilian face database that holds 14 images for each of 200 individuals, a total of 2800 images. All images are colorful and standing frontal position with profile rotation up to about 180 degrees. Age of persons between 19 to 40 years old with distinct appearance, hairstyle, and adorns [47].

V. OBJECTIVE OF PROPOSED METHOD

- Trying to find the face within the large database of face and increase the recognition rate of the face recognition. Proposed method can work well in different angle compare to PCA algorithm. In this approach the system returns the image which has nearest distant between input image and database image.
- Proposed approach decreases the false mate rate so it is suitable for real time application.

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VI. LITERATURE REVIEW [85].

Method Name	Overview	Characteristics	Drawback
Knowledge-based methods [25]	• Capture our knowledge of faces, and translate them into a set of rules • Ruled-based methods	• Easy to implement	• the features of the image can be corrupted due to noise, illumination. It uses different edge methods. • easy to guess some simple rules • difficulty in building an appropriate set of rules • false positives if the rules were too general • false negatives if the rules were too detailed • hierarchical knowledge-based methods used for this but it detect face based on textures or the color of human skin
Feature-invariant methods [25,32]	• Distinctive features of the face like Mouth, Nose, Eye, Cheekbones, Chin, Lips, Forehead, Ears	• find invariant features of a face anyway of it's angle or position	• Facial expression
Template matching methods [25]	• Compare input images with stored patterns of faces or features • Different features can be defined independently for example; a face can be divided into eyes, face contour, nose and mouth. Also a face model can be built by edges	• simple to implement	• Limited to faces that are frontal. • pattern of the face is manually predefined. • A face can also be represented as a shape. • Other templates use the relation between face regions in terms of brightness and darkness. • This approach is simple to implement, but it's insufficient for face detection. • It cannot achieve good results with variations in pose, scale and shape
Appearance-based methods Eigenface- [3,8,20,25] Distribution [25,82,84]	• Eigenface- • Based on Principal Component Analysis [PCA reduces the dimension of the data] • It Compare two faces by projecting the images into faces speed and measuring the distance between them.	• Relatively simple • Fast • Robust • Work well with high dimension	• Different head pose • Different alignment • Different facial expression • All face images must be in exact same size or same dimensions
	• Distribution • Based on Fisher's Linear Discriminant Analysis [LDA maximizes the between-class scatter LDA minimizes the within-class scatter] • Fisherface Uses 'within-class' information to maximise class separation	• Faster than eigenfaces, in some cases • Has lower error rates • Works well even if different illumination • Works well even if different facial express	• Small databases • The face to classify must be in the DB • Can't work well with high dimension

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ISSN: 2278-0181
Vol. 6 Issue 12, December - 2017

VII. PROPOSED ALGORITHM

Step 1: Input Coloured Image.
Step 2: Convert coloured image into grayscale.
Step 3: Find the mean of the image.
Step 4: Subtract the mean from each row in the gray scale image.
Step 5: Execute local binary pattern on result of step 4.
Step 6: Calculate the eigenvectors and eigenvalues on that LBP Image in a matrix.
Step 7: Verification of inputted image with user database images using Euclidean distance measurement method.
Step 8: Retrieved image from user database which has a minimum distance between input image and Database images.

VIII. IMPLEMENTATION OF PROPOSED ALGORITHMS USING MATLAB

Step 1: Input Colour Image.

Fig 8.1. Colour Image

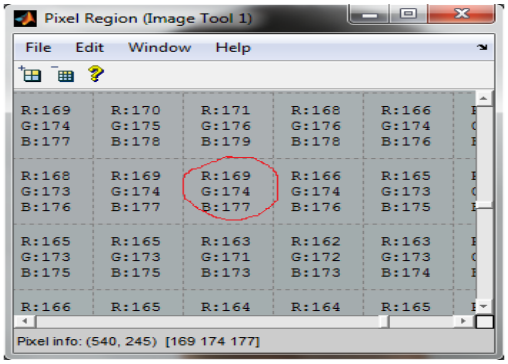

Fig 8.2. Pixel Value of Input Image using imtool

Step 2: Convert coloured image into grayscale.

Fig 8.3 Grayscale

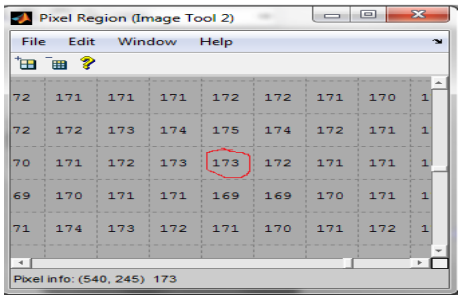

Fig 8.4. Pixel Value of Gray Scale Image using imtool

Step 3: Find the mean of the image.

Find the mean of the each row using a mean function.

Fig 8.5. Mean of Image

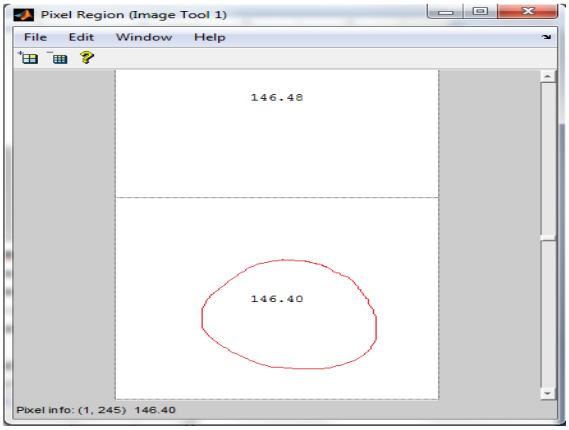

Fig 8.6. Mean Value of the Image using imtool

Step 4: subtract the mean from each row in the grayscale image.

Fig 8.7. Shift Image

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 12, December - 2017

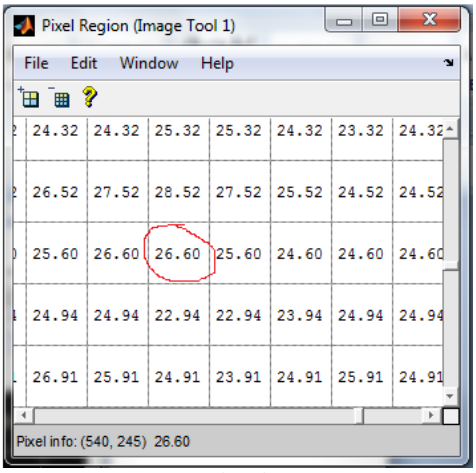

Fig 8.8. Pixel Value of Shift Image using imtool

Step 5: Execute local binary pattern on result of step 4.

Here LBP works with eight neighbours of a pixel in which centre pixel value is worked as a threshold. If the gray value of the neighbor pixel is maximum than the center pixel value in that condition assign one else its value is 0. Here execute local binary pattern in step 4

27.52	28.52	27.52
26.60	26.60	25.60
24.94	22.94	22.94

1	1	1
0	0	0
0	0	0

0	0	0
0	224	0
0	0	0

Here, the center pixel value = threshold value = 26.60.Compare each pixel value with a center pixel value. If the value is greater than the threshold then considering that pixel value as 1. After thresholding above 3×3 matrix is becomes,So LBP is 1 1 1 0 0 0 0 0 and decimal value for that is 224.This procedure is repeated for the whole Image.

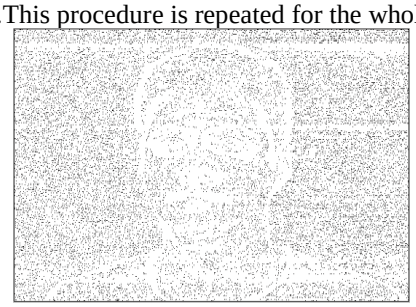

Fig 8.9. LBP of Proposed Algorithm

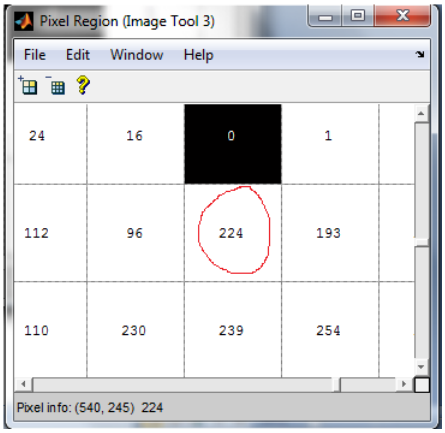

Fig 8.10. Pixel Value of LBP using imtool

Step 6: Calculate the eigenvectors and eigen values on that LBP Image in a matrix.

Calculation of eigenvectors and eigen values called as eigenface on the LBP Image in a matrix.

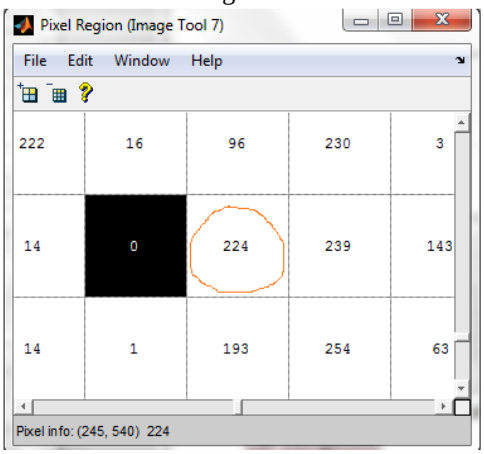

Fig 8.11. Pixel value of LBP'

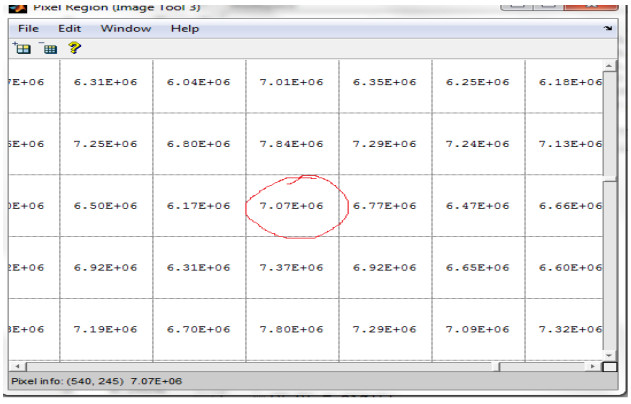

Fig 8.12. LBP * LBP'

Find eigenvector and eigen value using eig[] Matlab function. That calculates the eigenvector and eigen value of given matrix.

International Journal of Engineering Research & Technology (IJERT)
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Vol. 6 Issue 12, December - 2017

```
eigen_v =

   1.0e+09 *

    0.0000
    0.0880
    0.1081
    0.1357
    0.1448
    0.1599
    0.2038
    0.2865
    0.3207
    0.4070
    0.4784
    0.5388
    0.6674
    0.8273
    1.2415
```

Fig 8.13. Eigen Value

```
feature_vec =

   1.0e+08 *

   -0.0000
    0.2288
   -0.5874
   -0.2483
   -0.2716
    0.0366
   -0.3564
   -0.3436
   -1.0885
    1.5354
   -1.2863
   -1.6339
   -0.2249
   -1.0438
   -1.6331
```

Fig 8.14. Feature Vectors of the Input Image

Step 7: Verification of inputted image with user database images using Euclidean distance measurement method. Euclidean distance means measurements of similarity and dissimilarity. Calculate the distance between input image and user database image.

$$d(x,y) = \sqrt{\sum_i^n [xi - yi]^2} \quad \text{.....[7.1.4]}$$

Step 8: Retrieved image from user database which has a minimum distance between the input image and Database images.

Here, Image will be retrieved which have a minimum distance between the input image and image database. We implement existing LBP, PCA and proposed algorithm.

Fig 8.15. Implementation of Existing LBP, PCA and Proposed Algorithm

IX. RESULT ANALYSES OF PCA AND LBP ALGORITHMS

1. TABLE I. PCA & LBP ON FEI FACE DATABASE

Subject	DB Images	Trainee Images	RR%		FMR%		Avg.Verification Time [In Seconds]	
			PCA	LBP	PCA	LBP	PCA	LBP
05	14	14	98.50	62.85	1.5	37.15	0.37	0.05
10	14	14	95.71	70.00	4.29	30.00	0.25	0.05
15	14	14	92.85	79.52	7.15	20.48	0.29	0.05
20	14	14	89.64	64.64	10.36	35.36	0.32	0.05

TABLE II. PCA, LBP AND PROPOSED ALGORITHM ON FEI DATABASE [FOURTEEN TRAINEE IMAGES]

Subject	DB Images	Input Images	RR%			FMR%			Avg.Verification Time [S]		
			PCA	LBP	Proposed	PCA	LBP	Proposed	PCA	LBP	Proposed
5	5	14	82.85	68.00	92.85	17.15	32.00	07.15	0.04	0.04	0.04
10	5	14	75.71	65.00	90.71	24.29	35.00	09.29	0.05	0.05	0.06
15	5	14	76.66	70.47	84.28	23.34	29.53	15.72	0.05	0.06	0.04
20	5	14	75.71	69.64	84.64	24.29	30.36	15.36	0.06	0.06	0.07

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X. CONCLUSION

The different face recognition technique has been implemented using the hybrid technique of facial components. A novel approach has to be presented for face recognition, which creates a hybrid method by combining the LBP & PCA techniques. LBP has fastest execution time, so it is most suitable for real-time application. It is used to remove the illumination problem, but the problem is it works only on local regions of the image so that it cannot detain main features of large scale structures. PCA has a high accuracy rate, but it has illumination problem and pose problem. Here, we combine the advantages of LBP and PCA for a better result. The LBP and PCA two most commonly used methods are combined in a different way that increased recognition rate and decreased false match rate as well as not much more difference between verification times.

REFERENCES

[1] Hardik Kadiya, Comparative Study on Face Recognition Using HGPP, PCA, LDA, ICA and SVM, Global Journal of Computer Science and Technology Graphics & Vision ,Volume 12 Issue 15 Version 1.0 Year 2012 ,Type: Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc. [USA] Online ISSN: 0975-4172 & Print ISSN: 0975-4350 , Merchant Engineering College., globaljournals.org.

[2] P. Jonathon Phillips1, Patrick J. Flynn2, Todd Scruggs3, Kevin W. Bowyer2, Overview of the Face Recognition Grand Challenge, Proceedings of the 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition [CVPR'05].

[3] Prof. B.S PATIL Prof. A.R YARDI DrMrsPatil S B, Real Time Face Recognition By Varing Number of Eigenvalues , International Journal of Advanced Scientific and Technical Research Issue 3 volume 1, January-February 2013 ISSN 2249-9954, rspublication.com.

[4] LiorRokach ,Chapter 15 CLUSTERING METHODS Department of Industrial Engineering ,Tel-Aviv University ,OdedMaimon Department of Industrial Engineering Tel-Aviv University maimon, eng.tau.ac.il.

[5] ManeeshUpmanyu, Anoop M. Namboodiri, KannanSrinathan, and C. V. Jawahar, Blind Authentication: A Secure Crypto-Biometric Verification Protocol,IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 5, NO. 2, JUNE 2010, ieeexplore.ieee.org.

[6] Wilman W. W. Zou, ,Very Low Resolution Face Recognition Problem ,Student Member, IEEE, and Pong C. Yuen, Senior Member, IEEE, IEEE TRANSACTIONS ON IMAGE PROCESSING, VOL. 21, NO. 1, JANUARY 2012.

[7] PAUL VIOLA , MICHAEL J. JONES ,Real-Time Face Detection ,International Journal of Computer Vision ,57[2], 137–154, 2004 Kluwer Academic Publishers, Manufactured in The Netherlands. Robust viola@microsoft.com, mjones@merl.com, link.springer.com.

[8] Abhishek Nagar, KarthikNandakumar, and Anil ,Multibiometric Cryptosystems Based on Feature-Level Fusion., IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 7, NO. 1, FEBRUARY 2012.

[9] KoenSimoens, Julien Bringer, HervéChabanne, and StefaanSeys, A Framework for Analyzing Template Security and Privacy in Biometric Authentication Systems, IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 7, NO. 2, APRIL 2012, ieeexplore.ieee.org.

[10] Jianfeng Ren , Xudong Jiang, Junsong Yuan ,A complete and fully automated face verification system on mobile devices, a BeingThere Centre, Institute for Media Innovation, Nanyang Technological University, 50Nanyang Drive, Singapore 637553,Singapor, Electrical & Electronic Engineering ,Nanyang Technological University, ,NanyangLink,Singapore639798, Singapore, Elsevier.

[11] Ali Javed, Face Recognition Based on Principal Component Analysis ,Taxila, I.J. Image, Graphics and Signal Processing, 2013, 2, 38-44 Published Online February 2013 in MECS DOI: 10.5815,ijigsp.2013.02.06, www.mecs-press.org.

[12] Anil K. Jain, Brendan Klare and Unsang Park, Department of Computer Science and Engineering Michigan State University East Lansing, MI, U.S.A,, Face Recognition: Some Challenges in Forensics.

[13] Andrew Wagner, John Wright, Arvind Ganesh, Zihan Zhou, HosseinMobahi, and Yi Ma, Towards a Practical Face Recognition System: Robust Alignment and Illumination by Sparse Representation.

[14] K. Fukunaga[1989], Statistical Pattern Recognition New York: Academic Press, 1989, https:,,books.google.co.in.

[15] M. Gu, S.C. Eisenstat[1994], A Stable and Fast Algorithm for Updating the Singular Value Decomposition Research Report YALE DCR,RR-996, 1994, Yale University ,New Haven, CT, www.ijera.com.

[16] S. Chandrasekaran, B.S. Manjunath, Y.F.Wang, J. Winkeler, and H. Zhang [1997], An Eigenspace update algorithm for image analysis, journal of Graphical Model and Image Processing, 1997.

[17] A.L. Yuille, D.S. Cohen, and P.W. Hallinan[19889], Feature extraction from faces using deformable templates proc. CVPR, San Diego, CA, June 1989.

[18] Vinay Rishiwal, Ashutosh Gupta, Improved PCA Algorithm for Face Recognition, World Applied Programming, Vol[2], Issue [1], January 2012. 55-59,,Special section for proceeding of International e-Conference on Computer Engineering [IeCCE] ,2012,ISSN: 2222-2510 ©2011 WAP journal, www.waprogramming.com.

[19] Gunjan Dashore, Dr.V.CyrilRa, AN EFFICIENT METHOD FOR FACE RECOGNITION USING PRINCIPAL COMPONENT ANALYSIS [PCA], ,International Journal of Advanced Technology & Engineering Research [IJATER], ,ISSN NO: 2250-3536 VOLUME 2, ISSUE 2, MARCH 2012, www.ijater.com.

[20] Dr. H. B. Kekre, AkshayMaloudeep D. Thepade, Eigenvectors of Covariance Matrix using Row Mean and Column Mean Sequences for Face Recognition, International Journal of Biometrics and Bioinformatics [IJBB], Volume [4]: Issue [2], 2013, www.slideshare.net.

[21] Abhishek Nagar , Biometric Template Security ,A Dissertation Submitted to Michigan State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy Computer Science 2012, biometrics.cse.msu.edu.

[22] E. Mordini and S. Massari.,Body, biometrics and identity. Bioethics, 22[9]:488– 498, 2008.

[23] J.D. Woodward. ,Biometrics: privacy's foe or privacy's friend? ,Proceedings of the IEEE, 85[9]:1480 – 1492, 1997.

[24] Brendan F. Klare Mark J. Burge Joshua C. Klontz, Richard W. VorderBruegge and Anil K. Jain, Face Recognition Performance: Role of Demographic Information, ieeexplore.ieee.

[25] Proyecto Fin de Carrera, Face Recognition Algorithms, June 16, 2010 Ion Marques, www.ehu.eus.

[26] Face Recognition using Neural Networks,,Signal Processing: An International Journal [SPIJ] Volume [3]:Issue [5].

[27] Lindsay I Smith ,A tutorial on Principal Components Analysis, ,February 26, 2002, https:,,www.scribd.com.

[28] Mukesh Gollen ,COMPARATIVE ANALYSIS OF FACE RECOGNITION ALGORITHMS, IJREAS Volume 2, Issue 2 [February 2012] ISSN: 2249-3905 ,International Journal of Research in Engineering & Applied Sciences, www.euroasiapub.org.

[29] Kiran K. Panchal,3D Face Recognition on GAVAB Dataset, ,International Journal of Engineering Research & Technology [IJERT], ISSN: 2278-0181 Vol. 2 Issue 6, June – 2013, www.ijert.org.

[30] Zhang Baochang and et al [2007]: Histogram of Gabor Phase Patterns [HGPP]., A Novel Object Representation Approach for Face Recognition ,IEEE Transactions on Image Processing, vol. 16, No.1, pp 57-68.

[31] Pantic M. ,Automatic analysis of facial expressions: the state of the art , Dept. of Media Eng. & Math., Delft Univ. of Technol., Netherlands ; Rothkrantz, L.J.M., Pattern Analysis and Machine Intelligence, IEEE Transactions on [Volume:22 , Issue: 12] ieeexplore.ieee.org.

[32] T.Ojala, M. Pietillinen and T.Maenpaa, Multiresolutiongray-scale and rotation invariant texture classification with local binary patterns.,IEEE Trans, Pattern Anal. Mach.Intel., ,vol.24,no.7.pp.971-987.Jul.2002.

[33] Euclidean distance calculation code for matlab https://chrisjmccormick.wordpress.com/2014/08/22/fast-euclidean-distance-calculation-with-matlab-code/.
[34] Mohit P. GawandeProf.Dhiraj G. Agrawal , Face recognition using PCA and different distance classifiers ,IOSR Journal of Electronics and Communication Engineering [IOSR-JECE] ,e-ISSN: 2278-2834,p- ISSN: 2278-8735.Volume 9, Issue 1, Feb. 2014, PP 01-05, www.iosrjournals.org.
[35] Hussein Rady ,Face Recognition using Principle Component Analysis with Different Distance Classifiers ,IJCSNS International Journal of Computer Science and Network Security, ,VOL.11 No.10, October 2011.
[36] FEI Face Database. http://fei.edu.br/~cet/facedatabase.html
[37] Jie Yang, Hua Yu, An Efficient LDA Algorithm for Face Recognition ,William Kunz School of Computer Science Interactive Systems Laboratories Carnegie Mellon University Pittsburgh, PA 15213.
[38] Gonzalez,Woods,Eddins. Digital Image Processing Using MATLAB. 2nd edition, Gatesmark Publishing; 2009.
[39] Behrouz A. Forouzan. Cryptography and Network Security. 2nd edition McGraw-Hill; February 28th 2007.
[40] Image Encryption Algorithm. Mathsworks.com http://in.mathworks.com/matlabcentral/fileexchange/27698-image-encryption.
[41] Kshitij Bhetwal, Multimedia Security Using Encryption And Decryption, Information Technology ,Turku University Of Applied Sciences, 2016.
[42] Sourav Kumar Agrawal, High Security Image Encryption By 3 Stage Process , National Institute Of Technology Rourkela, May 2014.
[43] AbdenourHadid, Nicholas Evans, S´ebastien Marcel and Julian Fierrez, Biometrics systems under spoofing attack: an evaluation methodology and lessons learned, DRAFT,May 22, 2015.
[44] S. Basu, C. Neti, N. Rajput, A. Senior, L. Subramaniam, and A. Verma.Audio-visual Large Vocabulary Continuous Speech Recognition in the Broadcast Domain. In Multimedia Signal Processing, 1999.
[45] Andrew W. Senior. Face and Feature Finding for a Face Recognition System. In Second International Conference on Audio- and Video-based Biometric Person Authentication, pages 154–159, March 1999.
[46] Andrew W. Senior. Recognizing Faces in Broadcast Video. In IEEE International Workshop on Recognition, Analysis, and Tracking of Faces and Gestures in Real-Time Systems, pages 105–110, September 1999.
[47] ChalapathyNeti and Andrew W. Senior.Audio-visual Speaker Recognition for Broadcast News. In DARPA Hub 4 Workshop, pages 139–142, March 1999.
[48] Ian Craw and Peter Cameron. Face Recognition by Computer. In David Hogg and Roger Boyle, editors, Proceedings of the British Machine Vision Conference, pages 498–507. Springer Verlag, September 1992.
[49] Caifeng Shan, Shaogang Gong, Peter W. McOwan , Facial expression recognition based on Local Binary Patterns: A comprehensive study, Image and Vision Computing 27 [2009] 803–816.
[50] A.W. Senior , Face and Feature Finding for a Face Recognition System, In proceedings of Audio- and Video-based Biometric Person Authentication '99 pp. 154-159. Washington D. C. USA, March 22-24, 1999.
[51] Renu Bhatia, Biometrics and Face Recognition Techniques, International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277 128X, Volume 3, Issue 5, May 2013.
[52] Sujata G. Bhele V. H. Mankar, A Review Paper on Face Recognition Techniques, International Journal of Advanced Research in Computer Engineering & Technology [IJARCET], ISSN: 2278 – 1323, Volume 1, Issue 8, October 2012.
[53] Richa, JagroopKaurJosan, Face Recognition System – A Survey , International Journal of Science and Research [IJSR] ISSN [Online]: 2319-7064, Volume 4 Issue 1, January 2015 www.ijsr.net .
[54] Dr.Pramod Kumar, Mrs. Monika Agarwal , Miss. Stuti Nagar, A Survey on Face Recognition System - A Challenge, International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 5, May 2013, ISSN [Print] : 2319-5940 ISSN [Online] : 2278-1021.
[55] SaeedDabbaghchian, Masoumeh P. Ghaemmaghami , Ali Aghagolzadeh , Feature extraction using discrete cosine transform and discrimination power analysis with a face recognition technology, Contents lists available at Science Direct journal , Pattern Recognition 43 [2010] 1431–1440.
[56] Md. Abdur Rahim, Md. NajmulHossain, Tanzillah Wahid & Md. ShafiulAzam, Face Recognition using Local Binary Patterns [LBP], Global Journal of Computer Science and Technology Graphics & Vision Volume 13 Issue 4 Version 1.0 Year 2013.
[57] Ammad Ali, Shah Hussain, Farah Haroon, Sajid Hussain and M. Farhan Khan, Face Recognition with Local Binary Patterns, Bahria University Journal of Information & Communication Technology Vol. 5, Issue 1 December 2012.
[58] Brian O'Connor and Kaushik Roy, Facial Recognition using Modified Local Binary Pattern and Random Forest, International Journal of Artificial Intelligence & Applications [IJAIA], Vol. 4, No. 6, November 2013.
[59] TimoAhonen, MattiPietikainen, Face Description with Local Binary Patterns: Application to Face Recognition ,DRAFT , 5th June 2006.
[60] Unsang Park, "Face Recognition: face in video, age invariance, and facial marks" Michigan State University, 2009.
[61] A.Michealammal, k.SangeethaAnanthamani, Face detection And Face Recognition Using Adaboost algorithm And Local Binary Pattern Method, International Conference on Emerging Engineering Trends and Science [ICEETS – 2016], ISSN : 2348 – 8549 http://www.internationaljournalssrg.org.
[62] G. Yang and T. S. Huang, "Human Face Detection in Complex Background," Pattern Recognition, vol. 27, no. 1, pp. 53-63, 1994.
[63] T.K. Leung, M.C. Burl, and P. Perona, "Finding Faces in Cluttered Scenes Using Random Labeled Graph Matching," Proc. Fifth IEEE Int'l Conf. Computer Vision, pp. 637-644, 1995.
[64] K.C. Yow and R. Cipolla, "Feature-Based Human Face Detection," Image and Vision Computing, vol. 15, no. 9, pp. 713-735, 1997.
[65] Y. Dai and Y. Nakano, "Face-Texture Model Based on SGLD and Its Application in Face Detection in a Color Scene," Pattern Recognition, vol. 29, no. 6, pp. 1007-1017, 1996.
[66] J. Yang and A. Waibel, "A Real-Time Face Tracker," Proc. Third Workshop Applications of Computer Vision, pp. 142-147, 1996.
[67] S. McKenna, S. Gong, and Y. Raja, "Modelling Facial Colour and Identity with Gaussian Mixtures," Pattern Recognition, vol. 31, no. 12, pp. 1883-1892, 1998.
[68] R. Kjeldsen and J. Kender, "Finding Skin in Color Images," Proc. Second Int'l Conf. Automatic Face and Gesture Recognition, pp. 312-317, 1996.
[69] I. Craw, D. Tock, and A. Bennett, "Finding Face Features," Proc. Second European Conf. Computer Vision, pp. 92-96, 1992.
[70] A. Lanitis, C.J. Taylor, and T.F. Cootes, "An Automatic Face Identification System Using Flexible Appearance Models," Image and Vision Computing, vol. 13, no. 5, pp. 393-401, 1995.
[71] M. Turk and A. Pentland, "Eigenfaces for Recognition," J. Cognitive Neuroscience, vol. 3, no. 1, pp. 71-86, 1991.
[72] K.-K. Sung and T. Poggio, "Example-Based Learning for View-Based Human Face Detection," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 20, no. 1, pp. 39-51, Jan. 1998.
[73] H. Rowley, S. Baluja, and T. Kanade, "Neural Network-Based Face Detection," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 20, no. 1, pp. 23-38, Jan. 1998.
[74] E. Osuna, R. Freund, and F. Girosi, "Training Support Vector Machines: An Application to Face Detection," Proc. IEEE Conf. Computer Vision and Pattern Recognition, pp. 130-136, 1997.
[75] R.B.Modi, Human Face Detection in Images: A Survey, International Journal of Emerging Trends in Engineering and Development Issue 5, Vol.2 [Feb.-Mar. 2015].
[76] Rong Wang, Xiao Gang Yang, "A face detection method based on color and geometry information" , IEEE ,978-1-4577-2074-1,2012.
[77] Yogesh Tyal, Ruchika Lamba Subhransu Padhee, "Automatic Face Detection Using Color Based Segmentation", IJSRP,Vol-2, Issue 6, June 2012.
[78] Varsa Power, Aditi Jahagirdar, "Reliable face Detection in Varying Illumination and Complex Background",IEEE , pp.4577-2078. International conference on Communication, Information & Computing Technology, oct. 19-20, 2012.
[79] Marijeta Slavkovic, Dubravka Jevtic, "Face Recognition Using Eigenface Approach",Sarbian Journal of Elecrical Engineering, vol.9,No.1,February 2012.
[80] Hlaing Htake Khaung Tin, "Robust Algorithm for Face Detection in Color Images", I.J.Modern Education and Computer Science, 2012.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 6 Issue 12, December - 2017

[81] Wu-Chih Hu,Ching-Yu Yang, Deng-Yuan Huang and Chun-Hsiang Huang, "Feature based Face Detection Against Skin color Like Backgrounds with Varying Illumination", Journal of Information Hiding and Multimedia Signal Processing, vol.2, no.2, April 2011.

[82] K.-K. Sung, "Learning and Example Selection for Object and Pattern Detection," PhD thesis, Massachusetts Inst. of Technology, January 1996.

[83] I. Ozturk, I.Sogukpinar, "Analysis and comparison of image encryption algorithm", Journal of transactions on engineering computing and technology, December, vol. 3, 2004, p.38.

[84] K.-K. Sung and T. Poggio, "Example-Based Learning for View-Based Human Face Detection," IEEE Trans. Pattern Analysis and Machine Intelligence, vol. 20, no. 1, pp. 39-51, Jan. 1998.

[85] Dr. Kamini Solanki , Dr.Prashant P. Pittalia Review of Face Recognition Techniques", International Journal of Computer Applications[IJCA], Volume 133 No.12, January 2016.

[86] Kamini Solanki, " Biometric Key Generation In Digital Signature Of Asymmetric Key Cryptographic To Enhance Security Of Digital Data ",International Journal of Engineering Research and Technology , Volume 2, Issue 2.

[87] Prashant P Pittalia, Kamini Solanki, "An Invention Approach to 3D Face Recognition using Combination of 2D Texture Data and 3D Shape Data ",International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2 Issue 11.

[88] Kamini Solanki, "A New Approach To Symmetric Key Generation Using Combination Of Biometric Key And Cryptographic Key To Enhance Security Of Data", International Journal of Engineering Research & Technology, Volume 2, Pages 1-7.