International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

New Approach for Preventing Unauthorized Access and Key Generation from Facial Data

Dr. Kamini Solanki
Assistant Professor,
Faculty of IT & CS, Parul University
Vadodara, India

***Abstract*: Face Recognition is used for real time application and demanded application. This paper represents two modules. In first module, face recognition is done by combining local binary pattern (LBP) and principal component analysis (PCA) in different way. Proposed algorithm is used for better recognition rate. PCA is used for dimension reduction of image and LBP is used to describe the texture of image data. So hybrid approach will increase the recognition rate of face and also decreased false match rate but there is no difference in verification time. So it is suitable for real time application. We compared proposed method with both PCA and LBP to compute these changes. In case of execution time, there is no difference between of existing and proposed method. In Second module, key generation from feature vectors of proposed algorithm for the purpose of the security. According to the result proposed algorithm generate fastest key compared to the existing key.**

Key words: Facial image representation, LBP, PCA, Recognition rate, False match rate, Key Generation, Encryption, Decryption

1. INTRODUCTION

Face Recognition features can be done by global features and local features of face. Global features focus on the entire facial image so it has Less Accuracy. Local Features focus only local area of the face, which is help to identify and verify the person. So it is most accurate method. The local binary pattern (LBP) is design for local texture description and shape of an image. It is done by dividing an image into small parts from which local features are extracted. These local features consist of binary patterns which describe the location of pixels in those areas. The gained features from the regions are combined into a single feature histogram, which is represents the image. Images can be compared by distance measurement. It is based on local feature extraction and dimension reduction. In proposed method face recognition done by combining the LBP and PCA in different way which provides very good results. It increased the performance of recognition. It can work against face images with different facial conditions.

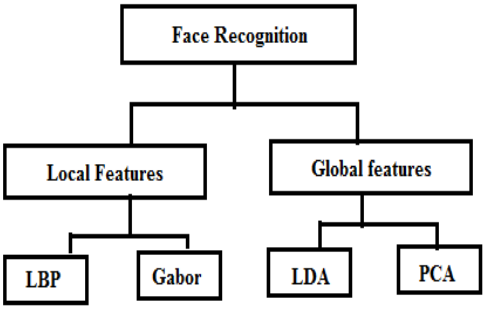

Fig.1 Face recognition methods

2. FACE RECOGNITION PROBLEM USING PCA ALGORITHM

2.1 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]

2.2 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]

3. 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]

4. 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]

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

5. OBJECTIVE OF PROPOSED METHOD

- Increased recognition rate
- Decreased false mate rate
- Biometric template security using cryptography
- Fastest key generation from facial feature

6. LOCAL BINARY PATTERNS

Local Binary Pattern (LBP) operator describes the texture and shape of a digital or gray scale image. LBP is a binary code for an image-pixel which describe local neighborhood of that pixel. This operator works with the eight neighbors of a pixel, using the value of this center pixel as a threshold. If a neighbor pixel has a higher gray value than the center pixel (or the same gray value) than a one is assigned to that pixel, else it gets a zero. The LBP code for the center pixel is then produced by concatenating the eight ones or zeros to a binary code.[43]

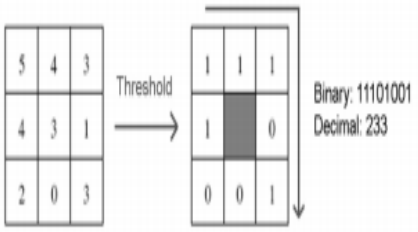

Fig. 2 The original LBP operator

Later the LBP operator can be extended. You can increase neighborhoods of different sizes. In that situation a circle is made with radius R from the center pixel. P sampling points on the edge of this circle are taken and compared with the value of the center pixel. To get the values of all sampling points in the neighborhood for any radius and any number of pixels, for neighborhoods the notation (P, R) is used. Fig 3 illustrates three neighbor-sets for different values of P and R and also called as multi scale LBP or extended LBP.[43]

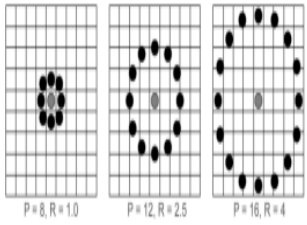

Fig. 3 circularly neighbor-sets for three different values of P and R.

LBP on FEI Database

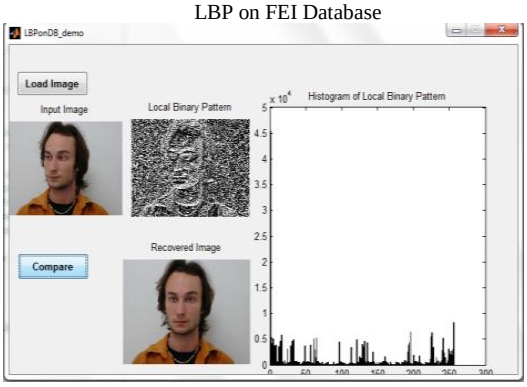

Fig. 4 LBP on FEI Database

7. PCA ALGORITHM

Principal Component Analysis (PCA) is well-organized method for face recognition. It is one of the most usable methods for a face image. It is used to reduce the dimensionality of the image and also holds some of the variations in the image data. It is projecting face image data into a feature space that covers the significant variations among known facial images. Those significant features are known as “Eigen faces”, because they are the eigenvectors or Principal Component of the set of faces. That is not necessary to correspond to the features such as eyes, ears, and noses. The projection operation characterizes an individual face by a weighted sum of the Eigen faces features. So to recognize a particular face, it is necessary only to compare these weights to those individuals. The Eigen Object Recognizer class applies PCA on each image, the results of which will be an array of Eigen values. To perform PCA several steps are undertaken: [8][20][19]

Stage 1: Subtract the Mean of the data from each variable (our adjusted data) subtraction of the overall mean from each of our values as for covariance we need at least two dimensions of data. It is in fact the subtraction of the mean of each row from each element in that row.

Stage 2: Calculate and form a covariance Matrix

$$cov(x,y) = \frac{\sum_{i-1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{(n-1)}$$

Stage 3: Calculate Eigenvectors and Eigen values from the covariance Matrix Eigen values are a product of multiplying matrices however they are as special case. Eigen values are found by multiples of the covariance matrix by a vector in two dimensional space (i.e. a Eigenvector). This makes the covariance matrix the equivalent of a transformation matrix.

Stage 4: Chose a Feature Vector (a fancy name for a matrix of vectors) Once Eigenvectors are found from the covariance matrix, the next step is to order them by Eigen value, highest to lowest. This gives you the components in order of significance. Here the data can be compressed and the weaker vectors are removed producing a lossy compression method, the data lost is deemed to be insignificant.

Stage 5: Multiply the transposed Feature Vectors by the transposed adjusted data. The final stage in PCA is to take the transpose of the feature vector matrix and multiply it with the transposed adjusted data set (the adjusted data set is from Stage 1 where the mean was subtracted from the data).

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

PCA on FEI Database

Fig. 5 PCA on FEI Database

8. COMPARISON OF PCA & LBP ALGORITHM

PCA Algorithm	LBP Algorithm
• High Recognition Rate • Global feature extraction	• Fastest execution time • Suitable for real time application • Illumination problem removal • Local feature extraction

9. PROPOSED ALGORITHM

Step 1: Find the mean image.
Step 2: Reallocate/instantiate array for the local binary pattern.
Step 3: LBP feature extraction using Feature Vectors.
Step 4: Calculate the ordered eigenvectors and eigenvalues
Step 5: Combine LBP local feature vectors with PCA global feature vectors.
Step 6: Key generation using these face features and encrypt image data using Euclidean and Euclidean Squared Distance Metrics method.
Step 7: Encrypted image data stored in database.
Step 8: Apply Step 1 to Step 6 if it is Inputted Image.
Step 9: Decrypt Database all image data using same key.
Step 10: Verification of Database images and inputted image using Ecudian distance measurement method.
Step 11: Retrieved image from database which have minimum distance between input image and Database images.

10. IMPLEMENTATION

10.1 Implementation of proposed algorithm

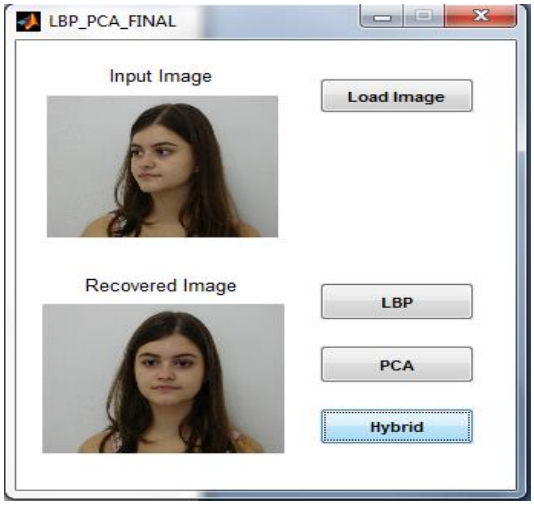

Fig.6 Implementation of proposed algorithm

10.2 Key Generation and Implementation of image cryptography

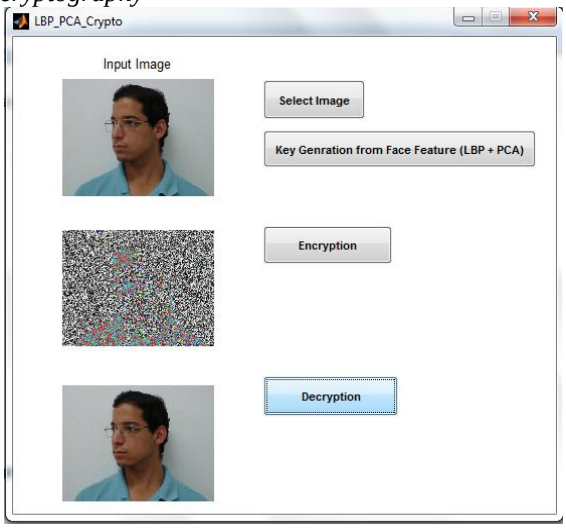

Fig. 7 Implementation of proposed algorithm on real time database

11. RESULT ANALYSES OF PCA AND LBP ALGORITHMS

Table 1. 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

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Table 2. PCA& LBP on Real time Database (6 trainee images)

Subject	DB Images	Input Images	RR%		FMR%		Avg.Verification Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	6	76.66	52.22	23.34	47.78	0.22	0.04
10	5	6	63.33	48.66	36.67	51.34	0.25	0.05
15	5	6	58.88	46.66	41.12	53.34	0.27	0.05
20	5	6	56.66	46.55	43.34	53.45	0.30	0.06

Table 3. PCA& LBP on Real time Database (14 trainee images)

Subject	DB Images	Input Images	RR%		FMR%		Avg.Verification Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	14	82.85	68.00	17.15	32.00	0.04	0.04
10	5	14	75.71	65.00	24.29	35.00	0.05	0.05
15	5	14	76.66	70.47	23.34	29.53	0.05	0.06
20	5	14	75.71	69.64	24.29	30.36	0.06	0.06

Table 4 proposed system on real time database (14 trainee images)

Subject	Database Images	Input Images	Recognition Rate (RR in %)	False Match Rate (FMR in %)	Avg.Verification Time (In Seconds)
05	5	14	92.85	7.15	0.04
10	5	14	90.71	9.29	0.06
15	5	14	84.28	15.72	0.04
20	5	14	84.64	15.36	0.07

Table 5 proposed system on real time database (3 DB images)

Subject	Database Images	Input Images	Recognition Rate (RR in %)	False Match Rate (FMR in %)	Avg.Verification Time (In Seconds)
05	3	14	88.57	11.43	0.03
10	3	14	79.28	20.71	0.04
15	3	14	71.90	28.10	0.05
20	3	14	72.85	27.15	0.05

Table 6 Comparison (Difference) of proposed algorithm with PCA and LBP

Subject	DB Images	Input Images	Increased RR%		Decreased FMR%		Diff. AVG.Veri.Time (In Seconds)	
			PCA	LBP	PCA	LBP	PCA	LBP
05	5	14	10.00	24.85	10.00	24.85	00.00	00.00
10	5	14	15.00	25.71	15.00	25.71	00.01	00.01
15	5	14	07.62	13.81	07.62	13.81	00.01	00.02
20	5	14	08.93	15.00	08.93	15.00	00.01	00.01

Table 7 Key Generation, Encryption, and Decryption of existing algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(In seconds)		
05	14	14	0.05	0.15	0.14
10	14	14	0.05	0.14	0.14
15	14	14	0.06	0.14	0.14
20	14	14	0.08	0.22	0.15

Table 8 Key Generation, Encryption, and Decryption of proposed algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(In seconds)		
05	14	14	0.00	0.12	0.12
10	14	14	0.00	0.12	0.12
15	14	14	0.00	0.13	0.11
20	14	14	0.00	0.13	0.11

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

Table 9 Difference between Key Generation, Encryption, and Decryption of existing algorithm and proposed algorithm

Subject	DB Images	Input Images	Key Generation	Encryption	Decryption
			(Decreased In seconds)		
05	14	14	0.05	0.03	0.02
10	14	14	0.05	0.02	0.02
15	14	14	0.05	0.01	0.03
20	14	14	0.05	0.09	0.04

12. CONCLUSION

LBP is fastest execution operator so it is most suitable for real time application. LBP feature vector used to remove illumination problem but it works only on local regional of image. So it cannot capture dominant features of large-scale structures. PCA has high accuracy rate but it has illumination and pose problem. If LBP feature vector combine with PCA Eigen vector according to this way, it remove the illumination and pose problem and also increased recognition rate and decreased false match rate as well as not much more difference between verification time. For the security purpose, image data is encrypted with the proposed feature vectors so it is used for the security of database template.

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.

[2] 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

[3] Prof. B.S PATIL1 Prof. A.R YARDI2, ,Dr Mrs Patil S B3, “REAL TIME FACE RECOGNITION BY VARING NUMBER OF EIGENVALUES”, International Journal of Advanced Scientific and Technical Research Issue 3 volume 1, January-February 2013 Available online on http://www.rspublication.com/ijst/index.html ISSN 2249-9954

[4] Lior Rokach , Chapter 15 CLUSTERING METHODS Department of Industrial Engineering Tel-Aviv University liorr@eng.tau.ac.il Oded Maimon Department of Industrial Engineering Tel-Aviv University maimon@eng.tau.ac.il.

[5] Maneesh Upmanyu, Anoop M. Namboodiri, Kannan Srinathan, 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

[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

[8] Abhishek Nagar, Student Member, IEEE, Karthik Nandakumar, Member, IEEE, and AnilK , “Multibiometric Cryptosystems Based on Feature-Level Fusion”. Jain, Fellow, IEEE, IEEE TRANSACTIONS ON INFORMATION FORENSICS AND SECURITY, VOL. 7, NO. 1, FEBRUARY 2012.

[9] Koen Simoens, Julien Bringer, Hervé Chabanne, and Stefaan Seys, 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

[10] Jianfeng Ren a,n, XudongJiang b, Junsong Yuan b , “A complete and fully automated face verification system on mobile devices” a BeingThere Centre,InstistuteforMediaInnovation,NanyangTechnologicalUniversity,50NanyangDrive,Singapore637553,Singapore b Electrical & ElectronicEngineering,NanyangTechnologicalUniversity, NanyangLink,Singapore639798,Singapore, Elsevier ,www.elsevier.com/locate/pr

[11] Thomas Heseltine, Face Recognition: A Literature Review, DPhil Research Student University of York ,2012

[12] Ali Javed Faculty of Telecom & Information Engineering, University of Engineering & Technology, “ 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 (http://www.mecs-press.org/) DOI: 10.5815/ijigsp.2013.02.06

[13] 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” {jain, klarebre, parkunsa}@cse.msu.edu

[14] Andrew Wagner, Student Member, IEEE, John Wright, Member, IEEE, Arvind Ganesh, Student Member, IEEE, Zihan Zhou, Student Member, IEEE, Hossein Mobahi, and Yi Ma, Senior Member, IEEE, “Towards a Practical Face Recognition System: Robust Alignment and Illumination by Sparse Representation”

[15] K. Fukunaga (1989) Statistical Pattern Recognition New York: Academic Press, 1989

[16] 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

[17] 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

[18] 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.

[19] Vinay Rishiwal1 Ashutosh Gupta2, 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

[20] Prof. B.S PATIL1 Prof. A.R YARDI2, ,Dr Mrs Patil 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 Available online on http://www.rspublication.com/ijst/index.html ISSN 2249-9954

[21] Gunjan Dashore, Dr. V.Cyril Ra,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.

[22] Dr. H. B. Kekre, SAkshay Maloudeep 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

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 8 Issue 07, July-2019

[23] 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
[24] E. Mordini and S. Massari. Body, biometrics and identity. *Bioethics*, 22(9):488– 498, 2008.
[25] J.D. Woodward. Biometrics: privacy's foe or privacy's friend? *Proceedings of the IEEE*, 85(9):1480 – 1492, 1997.
[26] Privaris inc. http://www.privaris.com/.
[27] Jianfeng Ren a,n, XudongJiang b, JunsongYuan b, "A complete and fully automated face verification system on mobile devices", Pattern Recognition, www.elsevier.com/locate/pr
[28] Brendan F. Klare, Member, IEEE, Mark J. Burge, Senior Member, IEEE, Joshua C. Klontz, Richard W. Vorder Bruegge, Member, IEEE, and Anil K. Jain, Fellow, IEEE, Face Recognition Performance: Role of Demographic Information,
[29] Proyecto Fin de Carrera , "Face Recognition Algorithms", , June 16, 2010 Ion Marques
[30] P.Latha, Dr.L.Ganesan & Dr.S.Annadurai,Face Recognition using Neural Networks,Signal Processing: An International Journal (SPIJ) Volume (3):Issue (5)
[31] http://www.journals.elsevier.com/image-and-vision-computing/call-for papers/multibiometrics-and-mobile-biometrics/
[32] Proyecto Fin de Carrera , Face Recognition Algorithms, June 16, 2010 Ion Marques
[33] Lindsay I Smith ,A tutorial on Principal Components Analysis, February 26, 2002
[34] 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. http://www.euroasiapub.org
[35] Kiran K. Panchal, "3D Face Recognition on GAVAB Dataset", International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 www.ijert.org Vol. 2 Issue 6, June – 2013
[36] Vapnik N. (1995): The Nature of Statistical Learning Theory, Springer.
[37] 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.
[38] Ibrahiem M. M. El Emary, "On the Application of Artificial Neural Networks in Analyzing and Classifying the Human Chromosomes", Journal of Computer Science, vol.2(1), 2006, pp.72-75.
[39] N. Senthilkumar and R. Rajesh, "A Study on Edge Detection Methods for Image Segmentation", Proceedingsof the International Conference on Mathematics and Computer Science (ICMCS-2009), 2009,Vol.I, pp.255-259
[40] 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)Dec 2000
[41] J. Li, Y. Wang, T. Tan, and A.K. Jain. Live Face Detection Based on the Analysis of Fourier Spectra. In *Proceedings of SPIE Conference on Biometric Technology for Human Identification*, volume 5404, pages 296–303, Orlando, USA, March 2004.
[42] T.Ojala, M. Pietillinen and T.Maenpaa, " Multiresolution gray-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.
[43] https://chrisjmccormick.wordpress.com/2014/08/22/fast-euclidean-distance-calculation-with-matlab-code/
[44] Mohit P. Gawande, Prof. 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, Ver. VI (Feb. 2014), PP 01-05 www.iosrjournals.org
[45] Hussein Rady "Face Recognition using Principle Component Analysis Face Recognition using Principle Component Analysis with Different ifferent ifferent Distance istance istance Classifiers " IJCSNS International Journal of Computer Science and Network Security, VOL.11 No.10, October 2011
[46] http://fei.edu.br/~cet/facedatabase.html
[47] Sonali Patil and V R Udupi. Article: Segmentation of Preprocessed MR and CT Images Containing Tumors using Edge Detection and Watershed Segmentation. IJCA Special Issue on Confluence 2012 - The Next Generation Information Technology SummitCONFLUENCE(1):32-36, September 2012.
[48] Parwinder Kaur Dhillon. Article: A Novel framework to Image Edge Detection using Cellular Automata. IJCA Special Issue on Confluence 2012 - The Next Generation Information Technology Summit CONFLUENCE(1):1-5, September 2012.
[49] Narasimha A v Rao, M Ramanjaneyulu and M Devaraju. Article: Skewed Character Recognition using Permutation Invariant RAS Transform. IJCA Special Issue on Confluence 2012 - The Next Generation Information Technology Summit CONFLUENCE(1):37-41, September 2012.
[50] M Praneesh and Jaya R Kumar. Article: Novel Approach for Color based Comic Image Segmentation for Extraction of Text using Modify Fuzzy Possiblistic C-Means Clustering Algorithm. IJCA Special Issue on Information Processing and Remote Computing IPRC(1):16-18, August 2012.