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Face Recognition using Transform Domain Techniques

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Abstract : *Biometric system is one of the mainly adopted security system in the present world. This paper presents a face recognition biometric system using Dual tree complex wavelet transform(DTCWT). The technique is applied on Combined database for matching purpose. The reults are obtained in the terms of FAR, FRR, EER and TSR.*

Keywords - *DTCWT, Combined database*

I. INTRODUCTION

Security and authentication is one of the major issues faced in the real-time. Biometric is one of the solutions for this issue which uses the unique characteristics of the individual. Every person does posses unique physiological and behavioral characteristics. Using this feature of the person, it can be used to authenticate him/her based on the comparison with the previously saved samples. Biometrics is broadly classified into main two sections, they are Physiological Behavioral. Physiological is the type of biometric which uses the biological characteristics of the individual which is captured by the biometric system and Behavioral type depends on how the person performs a task. This type considers the style, stroke and knowledge of the individual. Different types of behavioral biometrics are voice, keystroke, gait etc. Physiological biometrics includes face, fingerprint, iris etc A brief study of biometric and its systems will show the real time application of it in security system. Biometrics is identifying a person based on his physiological and behavioral traits. This biometric system collects a number of data for person identity. It considers human face for the identification procedure in this type features are extracted from the captured image and compared with the previously stored images. The feature extracted may be the skin color, pixel or intensity value of the image. It is one of the highly adopted technique as if doesn't require the cooperation of the person to apply. This type of recognition produces a high rate of accuracy and low intrusiveness. And hence this technique is highly adopted in the place of surveillance, security check in, general identification procedure like in bank transactions, employee registration, driving license and also for the gender discrimination.

II. LITERATURE SURVEY

A system for face recognition is used in forensics and crime departments. In forensic face recognition, it deals with the recognizing human face in non-ideal conditions and real-time. Face recognition based on either identification or verification. And also some criteria's like aging, marks on the face, sketch recognition and recognition in a video is handled.[1] A system which fuses multiple image of the same person which is captured by different cameras are resulting in a meaningful image. Image of a camera from an angle by a camera may only cover one side of the face and hence Cylinder Head Module (CHM) methodology is proposed which track out the face subject in multiple cameras. The problem of recognition of a face from a video is then transferred to still face recognition. CHM model overcomes the problem of illumination changes, occlusion of objects in a video. And using these module outputs the image is fused to obtain high accurate result.[2] A system deals with the face recognition of different pose variations. Face recognition is easier when it is processed for canonical front view of the face. So, to obtain this front view the pose information is very much required. An image can be modeled as a 3D texture mapped ellipsoid and hence any image can be projected as a 2D image of a 3D ellipsoid at a certain pose. Both test and training images are projected on 3D ellipsoid according to poses. [4]

A system which uses weighted distance transform to obtain a better face recognition rate. Weighted distance transform (WDT) not only considers both the spatial distance between the pixels and the local intensity variations in spatiointensity domain. WDT estimation is done using FAST MARCHING technique which uses the Dijkstra's algorithm, which estimates the shortest path of the network. Frontal face data base is used to verify the result and it provides promising results against PCA and DCT.[5] A system of face recognition based on changes in age, illumination, pose and expression. In preprocessing stage of the system thresholding is applied to remove the hairy parts and also background information which is then divided into macro blocks.

Scale invariant feature (SIF) is extracted from each macro block using SIF transform and then refined by Taylor transformation technique and dominant orientation to every point. And finally common features of these blocks are obtained and reclassified by byes classifier. 60% accuracy is attained by FG NET database compared to other proposed probability techniques.[6]. In this analysis is done on frequency domain and classified on gender using subjects of the image. Different image of same gender groups and variations due to sparse with respect every other image is considered. Exploiting this sparsity two feature will be extracted 1) common features of the face 2) denoting different faces in sample. Finally at the last these two features is combined to obtain the face recognition.[7]

A system is a multi frame resolution algorithm that is employed for face recognition. The system uses 2D DWT and uses the spatial variations in the face image. It uses the entropy based band selection for extraction of feature. Smaller fragmentation is done on the horizontal segments to get the variations. For each every segment the dominant wavelet coefficients are obtained as a feature extraction. Thresholding and the principal component analysis is used to reduce the dimension considerably to smaller size. The continued experimentation is carried out on database faces.[9] A system merges both the frequency and spatial domain techniques for face recognition. Ripplet and power law transformation is applied upon to obtain the key features standard deviation and the mean. Feed forward back propagation neural network is applied for classification and recognition.[12] A system for face recognition has larger databases. It has good results on storage capabilities and the computational time on both testing and training samples. This new algorithm is applied on Yale databases using DCT. It represents the images in transform domain. It obtains a high recognition rate and reduction in storage requirements with the high recognition rate. [13] A system employs multi scale DISCRETE WAVELET TRANSFORM for the preprocessing part. Face will be divided into four blocks and energy for each block is calculated and hence the complexity is reduced by factor 4. Maximizing this obtained block value the image is enhanced. K means clustering is applied on the face image that is obtained after preprocessing step and binary threshold is applied on the clusters. The testing of the images is done on ORL database.[14]

A system uses Overlap Local Binary Pattern (OLBP) technique on face images of transform domain. Two sets of information are produced by OLBP transform in which first set is obtained by the Dual Tree Complex Wavelet Transform (DTCWT) and second set is obtained by the DTCWT coefficients. The final feature is obtained by combining both set of results. This feature extracted test image is compared with database images by applying the Euclidean Distance (ED).[15] The system which helps in deciding the face region before the feature extraction procedure. It uses the YCbCr color space to recognize the face region. Transforms like DCT, WALSH, Haarand kekre's are applied and compared with all coefficients. Feature vectors are calculated by varying the coefficient size from left top corner of the coefficient matrix. The highest recognition rate of 83.16% is achieved using 2D DCT transform which uses a small feature vector of size 4*4.[16] A system combines both the DCT and the Nearest Neighbor Discriminant Analysis (NNDA) for face recognition. DCT is applied mainly for the discrimination analysis and for feature extraction as low frequency DCT coefficients carry most of the information and then NNDA is applied for discrimination analysis. For non matching faces 2-level DWT will be applied and they will be smoothened by zeroing it by vertical coefficients of DWT. These criteria will be considered and the images will be constructed with an accuracy of 99% and 98.5% on ORL and YALE databases respectively. [17]

III. PROPOSED METHODOLOGY

The proposed method provides the face recognition technique using DUAL TREE COMPLEX WAVELET TRANSFORM (DTCWT), is as shown in figure 1, which is a transform domain technique. The proposed method is classified into two sections

1. Enrollment section
2. Test section

Enrollment section includes loading of database, preprocessing of the loaded images of the database, feature extraction of the images using DTCWT technique. Test section includes loading of the test image sample, preprocessing of the test image followed by feature extraction of the image using DTCWT. And finally the matching section using Euclidean distance is applied on the test image comparing with the database images.

Loading database: The database is the set of data parameters which are used to compare the test samples. Many of the databases are collected on the requirement of the process. The images collected will be of different poses, illumination, brightness and expressions. There are many of the standardized publically available databases which have set their own standards.

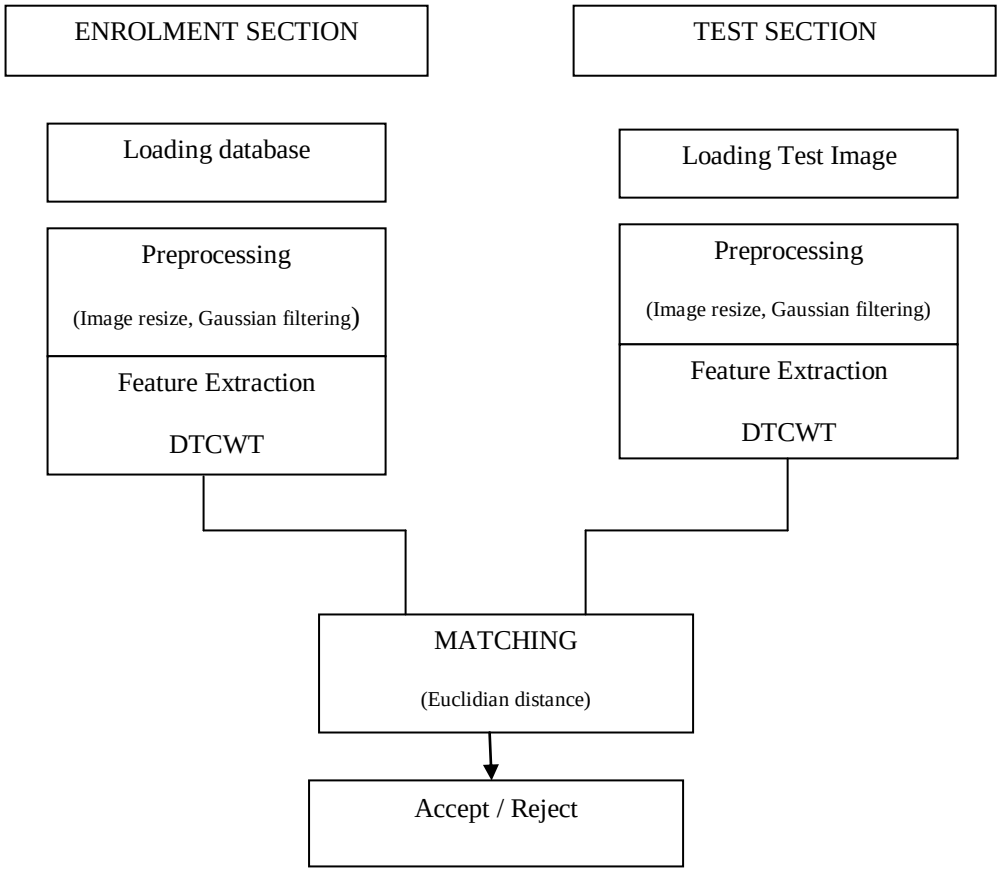


Fig 1: Block diagram of face recognition using DTCWT

The proposed method uses COMBINED database, which contains images of 120 individuals. Every individual's 19 images are collected of different poses, expressions. The image is resolute to the 320x280 size, as shown in table 1.

Table 1: Combined database

No of persons	Condition	Resolution	No of images
120	1. Facial expressions 2. Poses 3. Occlusions	320x280	2280

Pre-processing:

Pre-processing is done on the image before feature extraction to standardize the image and also for removing of the noise. Normalization, equalization are also other process applied to the image in pre-processing. Image resizing and Gaussian noise removal of the image is done in this approach.

- Image resize: In image resizing we can scale the image into required size in order to reduce the complexity. The size of the image that we capture from the biometric system or any camera will be of different size. Hence we will resize the image to 320x280 pixels. The resize of image includes either gray scale, RGB or a binary image.

- In the proposed system we use Gaussian filter for the images in the database and for test images in order to remove the Gaussian random noise and blurry characters. The 2-dimension Gaussian filter function is given by

$$G(x,y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-x^2+y^2}{2\sigma^2}}$$

The Gaussian filters works by using the 2D distribution as a point-spread function. Convolving the 2D-gaussian distribution function in the image provides this function.

Dual tree complex wavelet transform:

One of the basic methods of dual tree complex wavelet transform is by applying a one sample delay between level 1 filter in each tree. But the problem arises in the selection of odd and even filters approach. In order to overcome this problem the Q-Shift dual tree method is as show in the figure 2.

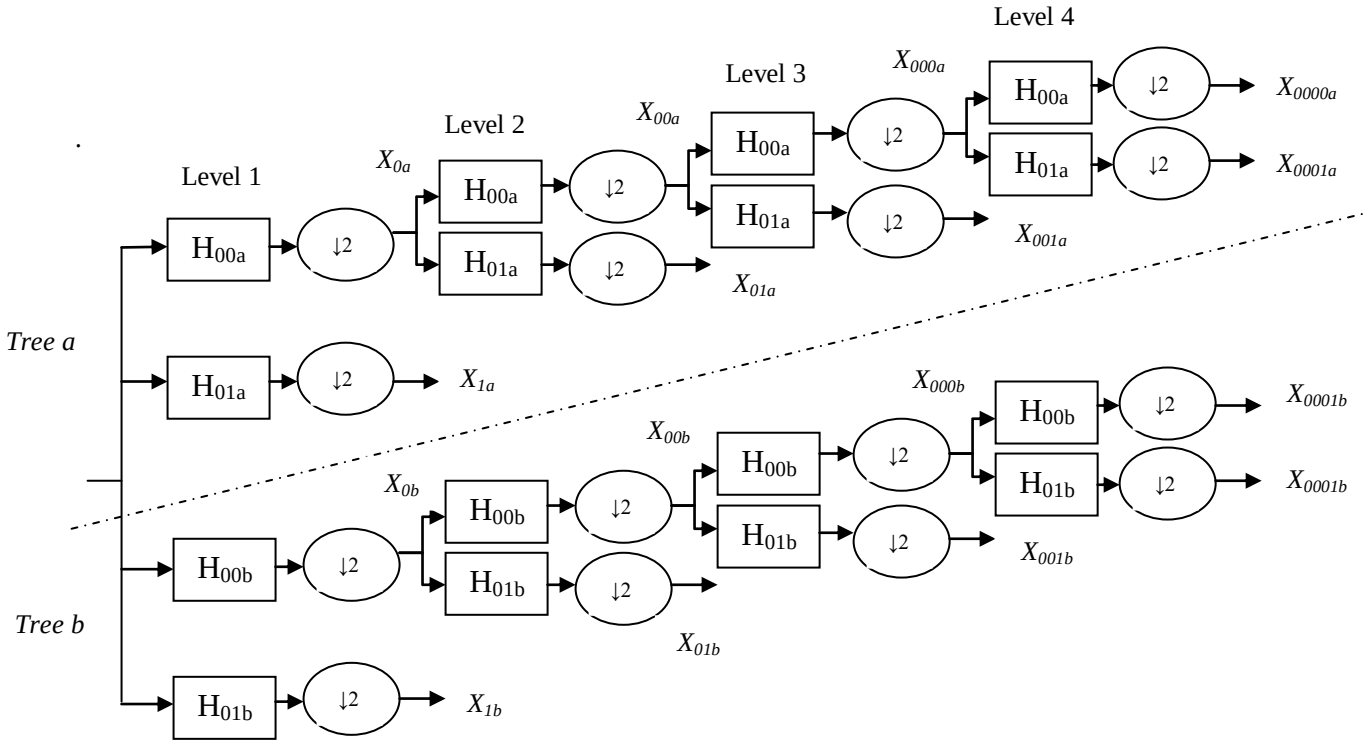


Fig 2: The 1D Q-shift dual tree structure

In the implementation of DTCWT there are two sets of filters are used, one set of filters are at level 1 and second set of filters are at higher levels. The filters which are used at higher levels are even length and having a group delay of approximately ¼. The time reverse of the tree provides the required delay difference of ½ samples in tree b. The real part of the complex wavelet coefficients are obtained at each scale in both tree. The complex coefficients are obtained only when the two trees are combined.

The 2 dimensional DTCWT is defined as $\psi(x,y) = \psi(x)\psi(y)$ for the row column transform implementation. Where ψ(x) and ψ(y) are two complex wavelets, in which

$$\psi(x) = \psi_u(x) + j\psi_l(x)$$

$$\psi(y) = \psi_u(y) + j\psi_l(y)$$

and $\psi_u(.)$, $\psi_l(.)$ are real wavelet transforms of upper filter band and lower filter band respectively. Then the following expressions are obtained,

$$\psi(x,y) = [\psi_u(x) + j\psi_l(x)][\psi_u(y) + j\psi_l(y) \quad (1)$$

$$= \psi_u(x)\psi_u(y) - \psi_l(x)\psi_l(y) + j[\psi_l(x)\psi_u(y) + \psi_u(x)\psi_l(y)]$$

The equation 1 possesses the full shift invariant properties of the one dimension transform. The real part of the six oriented complex wavelet of DTCWT can be defined as follows

$$\varphi_j(x,y) = \frac{1}{\sqrt{2}}[\psi_{1,j}(x,y) - \psi_{2,j}(x,y)]$$

$$\varphi_{j+3}(x,y) = \frac{1}{\sqrt{2}}[\psi_{1,j}(x,y) - \psi_{2,j}(x,y)] \quad (2)$$

Where j=1, 2, 3 and

$$\psi_{1,1}(x,y) = \varphi_u(x)\psi_u(y)\psi_{2,1}(x,y) = \varphi_l(x)\psi_l(y)$$

$$\psi_{1,2}(x,y) = \psi_u(x)\varphi_u(y)\psi_{2,2}(x,y) = \psi_l(x)\varphi_l(y)$$

$$\psi_{1,3}(x,y) = \psi_u(x)\psi_u(y)\psi_{2,3}(x,y) = \psi_l(x)\psi_l(y) \quad (3)$$

The six oriented imaginary part of complex wavelets of DTCWT can be defined as follows,

$$\xi_j(x,y) = \frac{1}{\sqrt{2}}[\psi_{3,j}(x,y) - \psi_{4,j}(x,y)]$$

$$\xi_{j+3}(x,y) = \frac{1}{\sqrt{2}}[\psi_{3,j}(x,y) - \psi_{4,j}(x,y)] \quad (4)$$

Where j=1, 2, 3 and

$$\psi_{3,1}(x,y) = \varphi_l(x)\psi_u(y)\psi_{4,1}(x,y) = \varphi_u(x)\psi_l(y)$$

$$\psi_{3,2}(x,y) = \psi_l(x)\varphi_u(y)\psi_{4,2}(x,y) = \psi_u(x)\varphi_l(y)$$

$$\psi_{3,3}(x,y) = \psi_l(x)\psi_u(y)\psi_{4,3}(x,y) = \psi_u(x)\psi_l(y) \quad (5)$$

In equation 4 and 5 $\varphi_u(.), \varphi_l(.)$ are the low pass functions of upper filter bank and lower filter bank respectively along the first dimension. $\psi_u(.)$, $\psi_l(.)$ are the high pass functions of upper filter bank and lower filter bank respectively along the second dimension. A 2D DTCWT produces three sub bands in each of spectral quadrants 1 and 2, giving six sub bands of complex coefficients at each level, which are oriented at ±15, ±45, ±75.

Matching:

This section does the comparison of the feature extracted from the test image with the features available in database. There is always a standard process for calculating and matching the results. The method we are using in this system is Euclidean distance(ED) formula for calculating the distance between the two samples. The resultant vector will always be a unique in nature and it changes for every slight change in the comparing images.

EUCLIDEAN distance of a line PQ connected by two points p, q is given by

$$d(q,p) = d(p,q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2}$$

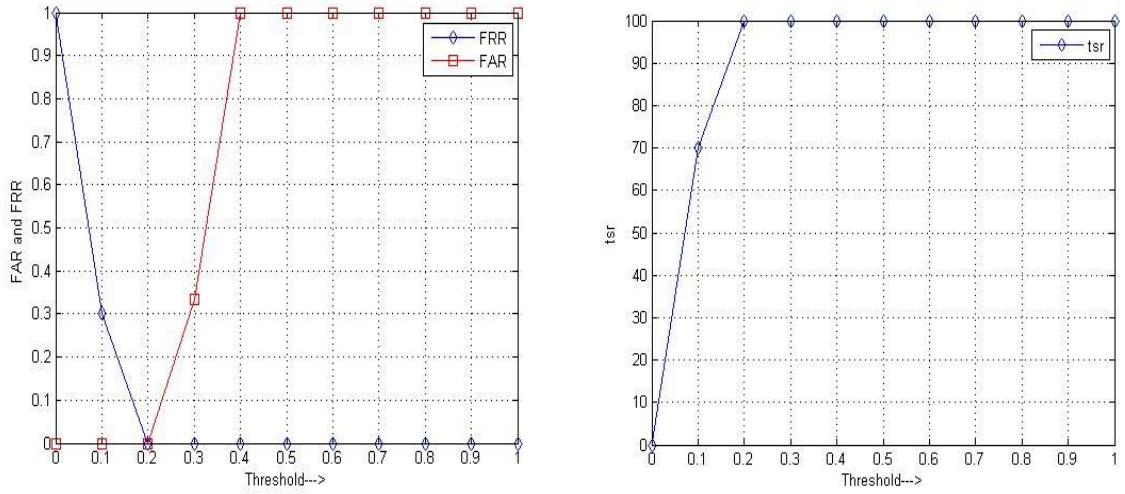
where p and q are in Cartesian co-ordinate p= (p_1, p_2…..p_n) and q= (q_1, q_2…q_n).

IV. RESULTS AND DISCUSSION

The combined database is considered with thirty persons with ten images per person in database for result analysis and the values of TSR for previous and proposed DTCWT model is shown in table 2. It is observed that the TSR values are more in case of proposed model compared to DWT in table 2 and we reduced the EER value to zero. The performance of proposed algorithm is improved by using DTCWT.

Table 2: Comparison of TSR value of proposed technique with existing technique

Author	Technique	TSR in %
Aman R.Chadha Pallavi P.Vaidya	DCT	94.5
Rangaswamy Y K B Raja	OLBP	95
Proposed	DTCWT	100



The above graph indicates EER of zero and TSR are of 100% obtained by using DTCWT by considering thirty persons with ten images of each individuals.

V. CONCLUSION

In this paper, we present a transform domain technique DTCWT for face recognition. The experiments are done by using the Combined database and the results that the DTCWT gives better recognition rate compared with the other transform techniques like DWT,OLBP etc…the results indicate that it would be a promising solution for face recognition in future.

REFERENCES

[1] Ali Cheraghain, Brendan Klare, and Unsang Park, "*Face Recognition: some challenges in Forensics," IEEE International Conference on Automatic Face and Gesture Recognition*, pp. 726-733, May 2011

[2] Chengliang Wang, Hu, Aggarwal .J. K, *"Fusing Face Recognition from Multiple Cameras," IEEE International Conference on Applications of computer vision*, pp.1-7, Feb. 2010

[3] GayathriMahalingam, Xiaoou Tang, *"Face Photo Sketch Synthesis And Recognition," IEEE International Conference on Pattern Analysis and Machine Intelligence*, pp. 1955-67, Sept. 2008

[4] Zhifeng Li, Myung Jin Chung, *"Pose-Robust Face Recognition Based On Texture Mapping,"IEEE International Conference on Machine Learning and Cybernerics*, pp. 46-51, Aug. 2008

[5] Muhammad Ashraf, ZubairSajid, Muhammad Sarim and Abdul BasitShaikh, *"Face Recognition Using Weighted Distance Transform" Proceedings of 2013 10th International Bhurban Conference on Applied Sciences & Technology (IBCAST)*

[6] S.Anith, D.Vaithiyanathan, R.Seshasayanan, "*Face Recognition System Based on Feature Extraction"*

[7] Duan-Yu Chen, Po-Chiang Hsieh, "*Face Based Gender Recognition Using Compressive Sensing*" *2012 IEEE International Symposium on Intelligent Signal Processing and Communication Systems (ISPACS 2012) November 4-7, 2012*

[8] Jaw]adNagi, Syed Khaleel Ahmed, FarrukhNag, "*A MATLAB Based Face Recognition System Using Image Processing and Neural Networks" 4th International Colloquium on Signal Processing and its Applications, March 7-9, 2008*

[9] Hafiz Imtiaz and ShaikhAnowarul Fattah**, "***A Face Recognition Scheme Using Wavelet based Dominant Features**" Signal & Image Processing : An International Journal (SIPIJ) Vol.2, No.3, September 2011*

[10] V.Vijayakumari*, "Face Recognition Techniques: A Survey" World Journal of Computer Application and Technology 1(2)2013*

[11] A. Abbas, M. I. Khalil, S. AbdelHay, Hossam M. A. Fahmy, *"Illumination Invariant Face Recognition in Logarithm Discrete Cosine Transform Domain"image processing (ICIP)2009 16th IEEE international conference*

[12] Md. IqbalQuraishi, "*A Novel Approach for Face Detection Using Artificial Neural Network" 2013 International Conference on Intelligent Systems and Signal Processing (ISSP)*

[13] WaleedAlrasheed, Wasfo B. Mikhael, *"A Qantized/Tuncated Transform Domain Technique (QTD) for Fast Facial Recognition"circuit and systems (MWSEAS),2011 IEEE 54th international Midwest simposium*

[14] ThamizharasiAyyavoo, Dr.Jayasudha J.S, *"Face Recognition Using Enhanced Energy of Discrete Wavelet Transform" 2013 International Conference on Control Communication and Computing (ICCC)*

[15] Rangaswamy Y*, "An OLBP Based Transform Domain Face Recognition" International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering (An ISO 3297: 2007 Certified Organization) Vol. 3, Issue 1, January 2014 Copyright to IJAREEIE www.ijareeie.com 6851*

[16] T. K. Sarode,PrachiPatil, *"Face Detection and Recognition in Digital Images Using Transform Domain Techniques" International Journal of Computer Applications (0975 – 888) Volume 48– No.20, June 2012*

[17] Surya Kant Tyagi and PriteeKhanna, *"Face Recognition Using Discrete Cosine Tansform and Nearest Neighbor Discriminant Analysis" IACSIT International Journal of Engineering and Technology, Vol. 4, No. 3, June 2012*

[18] V.Radha and N. Nallammal, *"Curvelet Texture Based Face Recognition Using Principal Component Analysis"*

[19] EslamMostafa, *"Pose Invariant Approach for Face Recognition at Distance" Computer Vision – ECCV 2012 Lecture Notes in Computer Science Volume 7577, 2012, pp 15-28*

[20] Rabab M. Ramadan and Rehab F. Abdel –Kader*, "Face Recognition Using Particle Swarm Optimization Basedselected Features*" International Journal of Signal Processing, Image Processing and Pattern Recognition Vol. 2, No. 2, June 2009

[21] Aman R Chadha, Pallavi P.Vaidya, M. Mani Roja "Face recognition using discrete cosine transform for global and local features*" Proceedings of the 2011 International Conference on Recent Advancements in Electrical, Electronics and Control Engineering (IConRAEeCE)*