Improving Far and FRR of an Iris Recognition System

Neha Kochher
Assistant Professor
Department of Computer Engineering
DAV College Jalandhar India

Sahil Kochher
Assistant Professor
Department of Computer Engineering
KRM DAV College Nakodar India

Abstract

The richness and apparent stability of the iris texture make it a very strong biometric trait for personal authentication. The need of personal identification and security has increased a lot during recent times. A typical iris recognition procedure basically consists of four steps: image acquisition, segmentation, normalization and feature extraction. A very well-known existing technique, the Hough Transform has been implemented for detection of iris and pupil boundaries of the eyes. In the existing system the performance of system degrades due to noise effects and poor segmentation results. The noise in the form of eye lids is removed by Daugman's method.

Keywords: Iris, Hough Transform, Daugman's Method

I. INTRODUCTION

Biometrics refer to the science that deals with the study of the automatic identification of a person based on his/her physiological or behavioral characteristics through means of measuring and analyzing biological data, such as fingerprints, eye retinas and irises, voice prints, facial patterns, hand geometry, etc., for authentication and security purposes .Biometric techniques helps to prevent unauthorized access or fraudulent use of cellular phones, smart cards, desktop PCs, workstations, and computer networks. A biometric system is basically a pattern recognition system, which makes personal identification by determining the authenticity of a specific physiological or behavioral characteristic possessed by the user. Biometrics techniques based identification is preferred over other methods such as passwords and PIN codes [10].

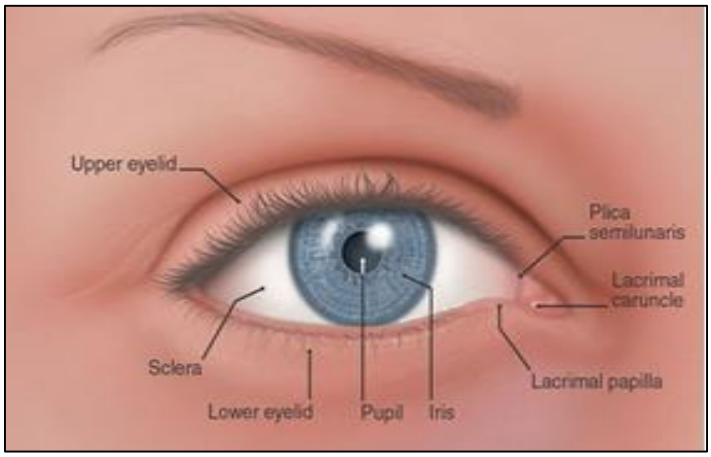

Fig. 1: View of human eye

Iris recognition is a part of biometric identification methods which also include face recognition, fingerprints and many other biological features. These are the new and quite reliable methods for a person identification, authentication and security [1]. Currently users have to carry security badges or certain known pin/pass codes in order to get into secure areas or to log in into a computer. Problem with these types of methods is that users have to remember a lot of passwords and pin codes. These are easy to guess and crack because users mostly prefer passwords that are easy to remember. Cards can be lost or theft and they can be used by anyone else to gain access to a restricted area, place or to a restricted computer. Biometrics on the other hand provide a secure and easy way of authenticating persons, biometrics can be combined with some other method like passwords or pin codes. They provide a very strong authentication method. Biometric identification utilizes the combination of many psychological and physical characteristics of an individual. Some of the common features are fingerprints, hand shapes, eyes retinas and many others including eye's iris. Physical and behavioural characteristics of a person include typing speed, walking style and signature etc. Out of all physiological properties iris patterns are believed to be one of the most accurate and efficient means of security. The process of iris recognition system is real-time and highly accurate. Iris recognition system has many security uses like it can be used to

authenticate a person's identity or to identify a certain person from a large set of databases. The iris is a protected internal organ of the eye basically located behind the cornea but in front of the eye lens. The iris has many unique features that can be used to distinguish one iris from another. One of the primary visible characteristic of the eye is the trabecular meshwork, it is basically a tissue which gives the appearance of dividing the iris in a radial pattern that is permanently formed by the eighth month of gestation period. During the development of the iris the unique feature is that there is no genetic influence on it, a process known as chaotic morphogenesis that occurs during the seventh month of gestation which basically means that even identical babies means, twins have uncorrelated minute, i.e. differing irises.

II. IRIS RECOGNITION SYSTEM DESIGN

The process to perform the complete iris recognition procedure can be divided into 5 main stages which are Image Acquisition, Image Segmentation, Iris Normalization, Feature Extraction and Matching as shown in following figure :

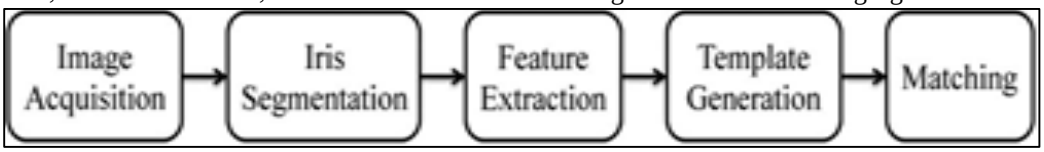

Fig. 2: Typical iris recognition system

The initial stage of the image acquisition is to capture the image of the eye. The second stage is to perform iris segmentation to identify the unique data patterns which is located at the iris region. Iris Normalization stage is to unroll the iris region to consistent size and remove the unwanted part of the image of the eye. Next the information of normalized iris region will be encoded and stored in measurable iris template or database. Finally the last step is iris template will be compared with the registered iris in the database for matching process [20].

III. IMAGE ACQUISITION

The iris image will be captured by using webcam or digital camera in digital form for the next stage which is iris segmentation or iris isolation.

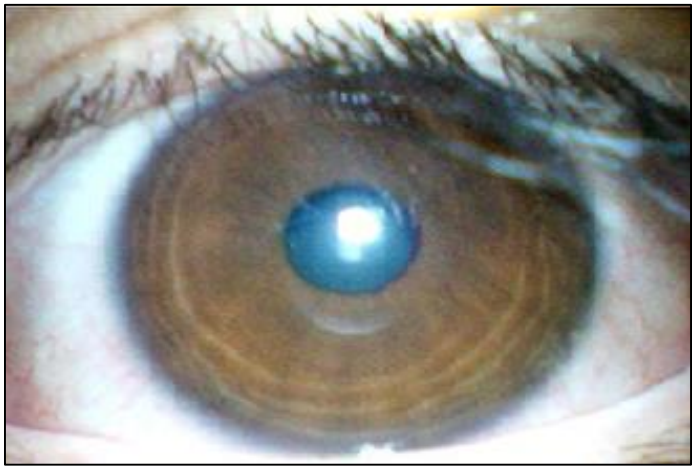

Fig. 3: The entire iris region captured

IV. IRIS SEGMENTATION

The iris segmentation is the very important and initial stage for image preparation for the iris recognition because it will direct affect the accuracy of the final matching result of the recognition system. In order to determine the best technique that can produced good performance of iris recognition two existing techniques have been chosen for image segmentation.

A. Hough Transform

The Hough transform is a method for finding lines, circles, or other simple forms and shapes in an image. The original Hough transform was basically a line transform, which is a very fast way of searching a binary image for straight lines. The transform can be further generalized and work upon to other cases than just simple lines. A classical Hough transform is most commonly used for the detection of regular curves such as lines, circles, ellipses, etc. in an image. A generalized Hough transform can be employed in different applications. In this case a simple analytic description of a feature is not possible.

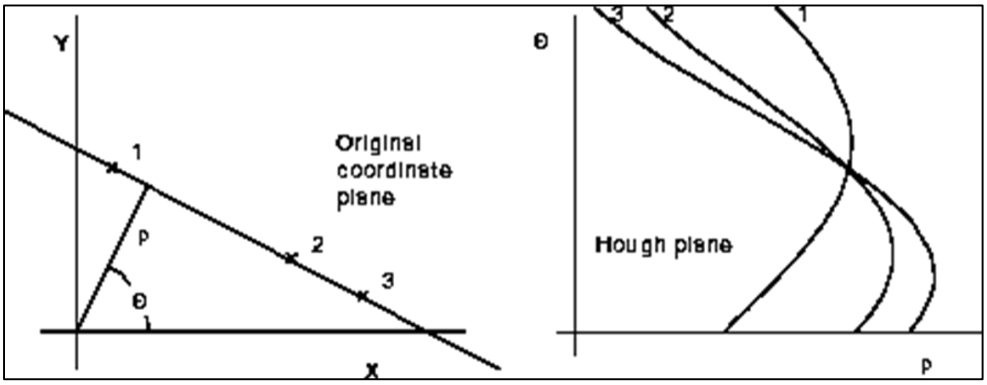

Fig. 4: Representation of Hough transform

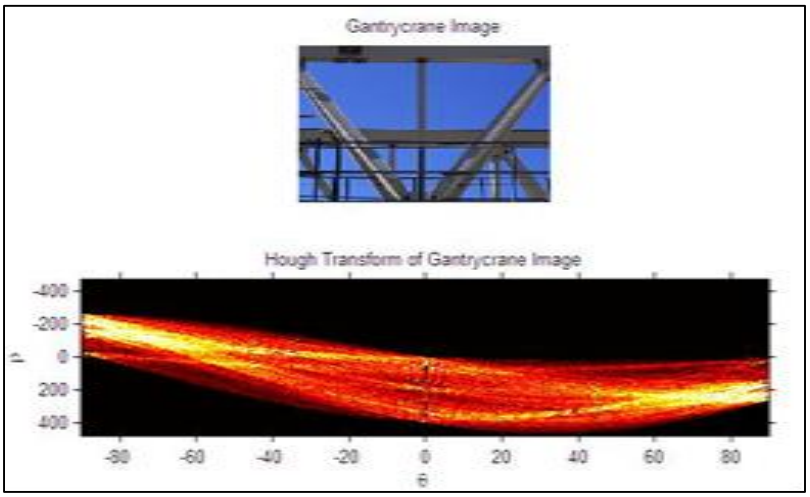

Fig. 5: Result of line detection

B. Generalized Hough Transform

The Hough transform was basically developed to detect analytically defined shapes (e.g., lines, circles, ellipses etc.). The generalized Hough transform can be used to detect arbitrary shapes which means shapes having no simple analytical form. It requires the complete specification of the exact shape of the target object or the image.

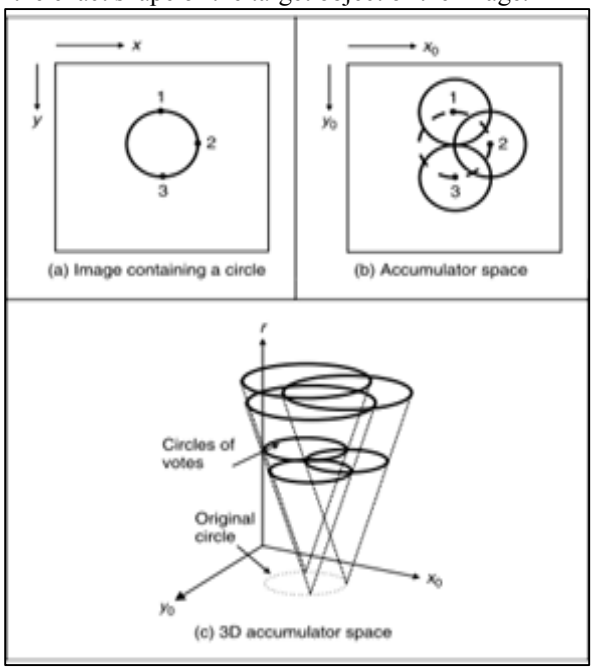

Fig. 6: Illustration of hough transform

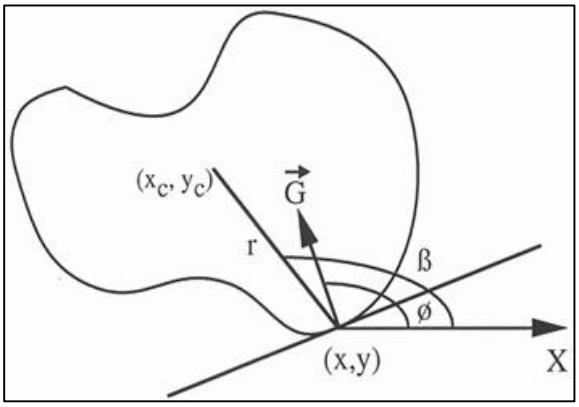

Fig. 7: Generalized hough transform

C. Daugman's Integro Differential Operator

This is by far the most cited and used method in the iris recognition literature. It is licensed to Iridium Technologies who turned it into the basis of 99.5% of the commercial iris recognition systems, which means it is best for commercial use. It was basically proposed in 1993 and was the first method effectively implemented and successful in a working biometric system. It is assumed that the both pupil and iris forms a circular formation. Basically Daugman's integro differential operator is used to reduce noise in the form of upper and lower eyelids regions of the eye [24].

V. IMAGE NORMALIZATION

Once the iris region is successfully segmented from an eye image, the next stage is to transform the iris region so that it has fixed dimensions in order to allow comparisons and this is called normalization.

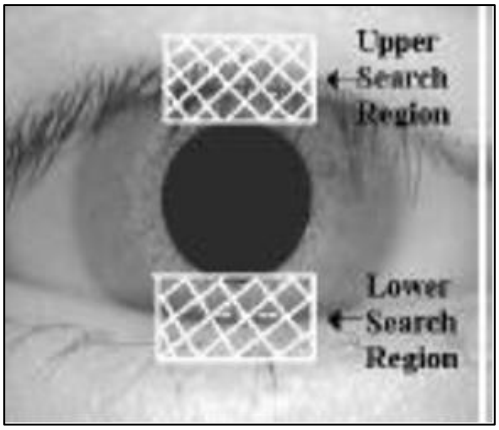

Fig. 8: Upper and lower search regions of the iris image.

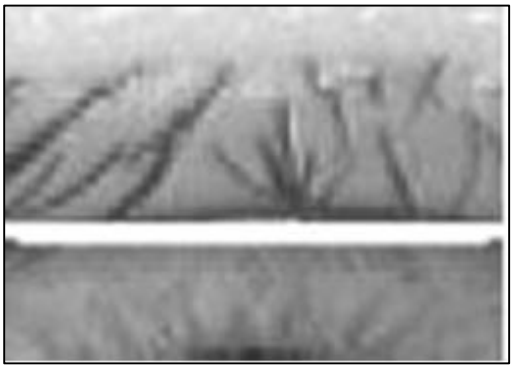
Fig. 9: Removal of eye lid noises.

The dimensional inconsistencies or irregularity between eye images are mainly due to the stretching of the iris caused by pupil dilation, dilation means moment of pupil from varying levels of illumination. Other sources of inconsistency basically include varying imaging distance, rotation of the camera, head tilt, and rotation of the eye within the eye socket.

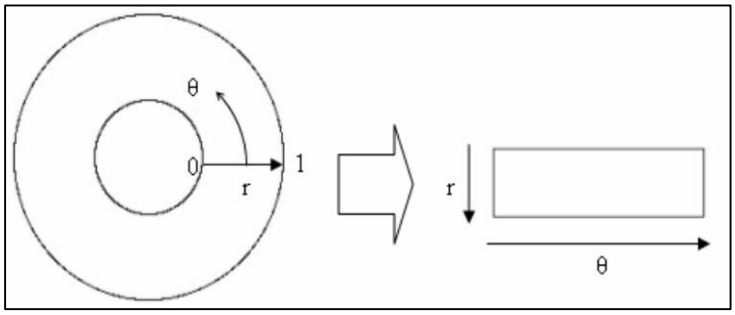

Fig. 10: Daugman's rubber sheet model

The normalization process will produce iris regions which have the same constant dimensions and in a particular pattern, so that two photographs or images of the same iris under different conditions will have characteristic features at the same spatial location on the basis of the dimensions of the image. Another important point to be noted is that the pupil region is not always concentric or in a circular form within the iris region [28]. The homogenous rubber sheet model devised by Daugman method remaps or matches each point of the image within the iris region to a pair of polar coordinates (r,θ) where r is on the interval [0,1] and θ is angle [0,2π] as shown in figure below:

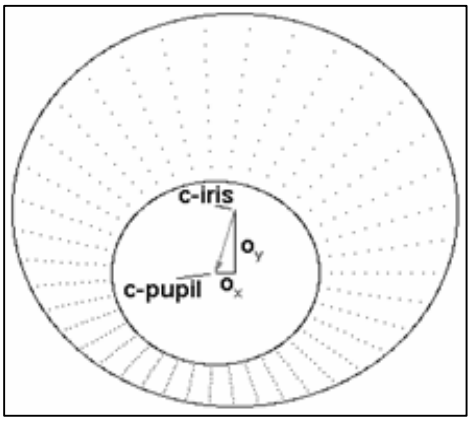

Fig. 11: Normalization.

VI. FEATURE ENCODING AND MATCHING

To provide an accurate and effective method of recognition of individuals, the features which are most distinctive and unique in an iris pattern must be extracted. Only these significant and essential parts must be extracted so that they can be encoded into biometric templates which can be used for comparisons. In order to have accurate recognition of individuals the important information present in an iris pattern must be extracted. Only the main features of the iris must be encoded so that comparisons between templates can be made [25].

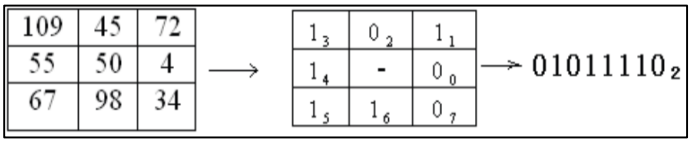

Fig. 12: Example of computing 8, 1 LBP.

VII. RESULTS

Following metrics are used to evaluate the performance of the system.

- False Acceptance Rate (FAR): FAR is the measure of the likelihood that the biometric security system will incorrectly accept an access or use by an unauthorized user or false access.
- False Rejection Rate (FRR): A false reject occurs when an individual is not matched or is not able to access to his/her own existing biometric template or database.

Experiments are basically performed on a CASIA image database. This database contains 756 gray-scale eye images (320 × 280 pixels) with 108 unique eyes image and 7 different images of each eye which is very useful. The above performance measuring parameters are evaluated by splitting total database of 80 persons into 60 and 20 persons. The set A with 20 persons is then repeated for same images from 81 to 90. The accuracy is determined or calculated by (Accuracy = 100 – (FAR+FRR)/2). A different database which consists of only real time images is also introduced for testing. The accuracy of the system is tested on that database

also for more efficiency. The FAR of the system is 0.01 and FRR of the system is 0.01 which gives an improved accuracy up to 99.99%.

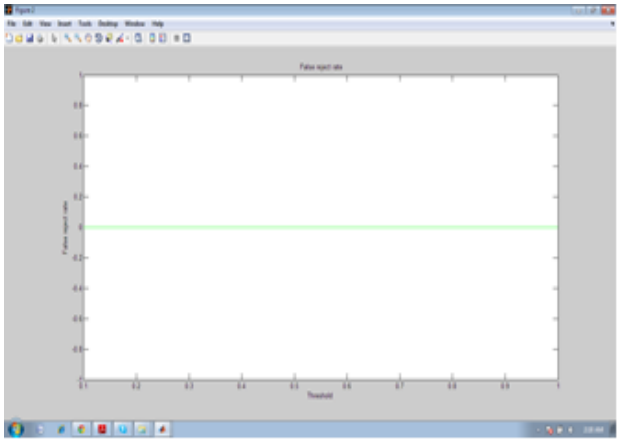

Fig. 13: False reject rate

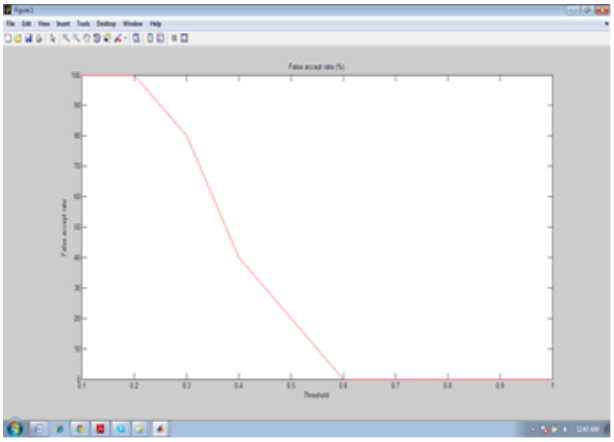

Fig. 14: False accept rate

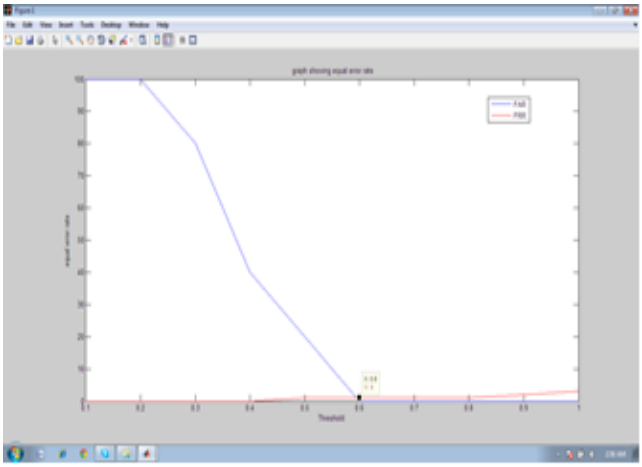

Fig. 15: Equal error rate.

VIII. CONCLUSION

As an conclusion, iris recognition system best works when we use both segmentation techniques, hough transform and daugman's integro differential operator. Both of these techniques have unique advantages. In this paper we basically work on improving false accept rate and false reject rate. Image normalization is performed by using daugman's rubber sheet model. Features are extracted using local binary patterns.

The combination of segmentation and quality scores is highly correlated with the recognition accuracy of the whole system and can be used to improve and calculate the performance of iris recognition systems. The evaluation of the performance for the iris recognition results is basically based on the analysis of both FAR and FRR curves. Experimental results show that the proposed algorithm is efficient and improves the accuracy of iris recognition system.

REFERENCES

[1] J. Woodward, N. M. Orlans, and P. T. Higgins, Biometrics. Berkeley, CA: McGraw-Hill, 2002.
[2] Chinese Academy of Sciences – Institute of Automation. Database of 756 Greyscale Eye Images. http://www.sinobiometrics.com Version 1.0, 2003.
[3] Libor Masek, "Recognition of Human Iris Patterns for Biometric Identification," M. Eng. thesis, School of Computer Science and Software Engineering, the University of Western Australia, 2003.
[4] J. Huang, Y. Wang, T. Tan, Jiali Cui, "A new iris segmentation method for recognition." In Proceedings of the 17th International Conference on Pattern Recognition, ICPR, Volume: 3, pp. 554- 557 Vol.3 2004.
[5] L. Ma, T. Tan, Efficient iris recognition by characterizing key local variations, IEEE Transaction Image Processing 13, 2004.
[6] B. J. Joung, J. O. Kim, C. H. Chung, Key Seo Lee, Wha Young Yim, Sang Hyo Lee, On Improvement for Normalizing Iris Region for a Ubiquitous Computing." In Proceedings of International Conference on Computational Science and Its Applications ICCSA, Singapore, May 9-12, 2005.
[7] K.W. Bowyer, K. Hollingsworth, P.J. Flynn, Image understanding for iris biometrics: a survey, Computer Vision Image Understand, pp. 281–307, 2005.
[8] N. D. Kalka, V. Dorairaj, Y. N. Shah, N. A. Schmid, and B. Cukic, "Image quality assessment for iris biometric," in Proc. Biometric Consortium Conf., Arlington, VA, 2005, pp. 58–59.
[9] E. Wolff. "Anatomy of the Eye and Orbit." 7th edition. H. K. Lewis & Co. LTD, 2005.
[10] Z.He,T. Tan, and Z. Sun. Iris localization via pulling and pushing "International Conference on Pattern Recognition" 2006.
[11] A. K. Khurana, Comprehensive Ophthalmology, New Age International (P) Ltd., 4th edition, 2007

[12] IEEE Transactions On Systems, Man, And Cybernetics—Part B, Cybernetics, Vol. 37, No. 5, October 2007
[13] http://iris.idealtest.org/findTotalDbByMode.do?mode=Iris
[14] International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 2, Issue 1, 2008.
[15] J. Huang, Y. Wang, T. Tan, and J. Cui, "A new iris segmentation method for recognition," Proceedings of the 17th International Conference on Pattern Recognition (ICPR), vol. 3, pp. 23–26, 2008.
[16] Kazuyuki Miyazawa, Koichi Ito, Takafumi Aoki, Koji Kobayashi, Hiroshi Nakajima," An Effective Approach for Iris Recognition Using Phase-Based Image Matching", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 30, No. 10, Oct. 2008.
[17] L. Rabiner and B. H. Juang, Fundamentals of Speech Recognition. Prentice Hall, Englewood Cliffs, 2008.
[18] L.Masek and P. Kovesi. MATLAB Source Code for a Biometric Identification System Based on Iris Patterns. The School of Computer Science and Software Engineering, The University of Western Australia, 2009.
[19] W. M. K. Wan Khairosfaizal and A. J. Noraini, "Eyes Detection in Facial Images using Circular Hough Transform", Colloquium of Signal Processing and its Application (CSPA 2009), Kuala Lumpur 2009.
[20] C. Belcher and Y. Du, "Region based SIFT approach to iris recognition," Opt. Lasers Eng., vol. 47, no. 1, pp. 139–147, Jan. 2009.
[21] R. Sanchez-Reillo and C. Sanchez Avila, "Iris recognition with low template size," in AVBPA, ser. Lecture Notes in Computer Science, J. Bigun and F. Smeraldi, Eds., vol.4, Springer, pp. 324–329, 2010.
[22] J.R. Matey, R. Broussard, and L. Kennell, "Iris image segmentation and sub-optimal images," Image and Vision Computing, vol. 28, no. 2, pp. 215–222, 2010.
[23] S V Sheela, P A Vijay a, ―Iris Recognition Methods–Survey International Journal of Computer Applications (0975–8887)Volume 3 – No.5, June 2010.
[24] Seifedine Kadry and Mohamad Smaili, "Wireless attendance management system based on iris recognition," Scientific Research and Essays, vol. 5, pp. 1428-1435, 18 June, 2010.
[25] Sudipta Roy, Abhijit Biswas, ―A Personal Biometric Identification Technique based on Iris Recognition (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 2 (4) , 2011.
[26] G-D. Guo and M. Jones. Method for localizing irises in images using gradients and textures, January 2012.
[27] IJCSI(International Journal of Computer Science Issues), Vol. 9, Issue 1, No 2, January ,2012
[28] International Journal of Engineering Research & Technology (IJERT), Vol. 1 Issue 5, ISSN: 2278-0181, July 2012.
[29] Libor Masek Recognition of human iris patterns for biometric identification. http://www.csse.uwa.edu.au/pk/studentprojects/libor.
[30] B. Kumar, C. Xie, J. Thornton, Iris verification using correlation filters, in Proceedings of 4th International Conference on Audio- and Video-Based Biometric Person Authentication, , pp. 697–705, 2012.
[31] IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 5, No 1, September 2012.
[32] Rafael C.Gonzalez, Richard E.Woods "Digital Image Processing "Second edition Pearson Education, Printice Hall.