International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Personal Authentication Based on Iris Recognition

Law Kumar Singh[1], Praveen Gupta[2]

Department of Computer Science & Engineering, Hindustan College of Science & Technology, Mathura (U.P.), India

Abstract: ***Iris recognition is the process of recognizing a person by analyzing the apparent pattern of his or her iris. Iris recognition is regarded as the most reliable and most accurate biometric identification system available. Algorithms produced by Professor John Daugman [2] have proven to be increasingly accurate and reliable after over 200 billion comparisons [3].In comparison to face, fingerprint and other biometric traits there is still a great need for substantial mathematical and computer-vision research and insight into iris recognition. Iris recognition is the most accurate and reliable biometric identification system available among other biometrics technique because even the iris of both the eyes of same individual are different . This project basically explains the Iris recognition system and attempts to implement the algorithms in MATLAB. Iris recognition is a biometric system for access control that uses the most unique characteristic of the human body. This paper proposes a personal identification using iris recognition system with the help of five major steps i.e. image acquisition, segmentation is performed using Canny Edge Detection and Hough Transformation, normalization, feature extraction using Local Binary Pattern and matching and also these five steps consists a number of minor steps to complete each step. The pupil and limbic boundaries are detected using Canny Edge Detection and Circular Hough Transformation. Then the iris image is transformed from Cartesian to polar coordinate. We perform feature extraction in which we extract the unique features of the iris image and then perform matching process on iris code using Chi-Square statistics for acceptance and rejection process. We are giving our research papers and our proposed technique works very well and can be easily implemented.***

Keywords: Biometrics, Canny Edge Detection, Circular Hough Transformation, Feature Extraction, Chi-square statistics

1. Introduction

A biometric system provide the automatic recognition of an individual basedon some sort of unique Feature or characteristics possessed by the individual. Biometric system have been developed based on the fingerprint, facial features, voice, hand geometry, handwriting, the retina and the one presented in this thesis, the iris. Biometric identification provides a valid alternative to traditional authentication mechanisms such as ID cards and passwords, whilst overcoming many of the shortfalls of these methods; it is possible to identify an individual based on who they are" rather than what they possess" or what they remember"[4]. Biometric systems works first by capturing a sample of the feature, such as recording a digital sound signal for a voice recognition, or taking a digital colorimage for the face recognition. The sample is then transformed using some sort of the mathematical function into a biometric template. The biometric template will provide a normalized, efficient and highly discriminating representation of the feature, which can then be objectively with other templates in order to determine the identity. Most biometric systems allow two modes of the operation. An enrollment mode for adding templates to a database, and an identification mode, where a template is created for an individual and then a match is searched for in the database of the pre-enrolled templates. A good biometric is characterised by use of a feature that is; highly unique so that the chance of any two people having the same characteristics will be minimal, stable so that the feature does not change over time, and be easily captured in order to provide convenience to the user, and prevent misrepresentation of the feature.

2. Background

Ophthalmologists Alphonse Bertillon and Frank Burch were one among the first to propose that iris patterns can be used for identification systems. In 1992, John Daugman was the first to develop the iris identification software. Other important contribution was by R. Wildes et al. Their method differed in the process of iris code generation and also in the pattern matching technique. The Daugman system has been tested for a billion images and the failure rate has been found to be very low. His systems are patented by the *IriscanInc*. and are also being commercially used in Iridian technologies, UK National Physical Lab, British Telecom etc.

3. Iris Recognition System

3.1 Image Acquisition

We consider Image acquisition is the major step, since all subsequent steps depend highly on the image quality. We will use CCD camera to take an image of an eye. Therefore, all eye images are to be jpeg image files of at least 100*100 pixels in dimension and the mode to white and black for greater details. The result is highly resolute image which is given as the input to our system for further processing. The user begins scanning an eye by turning the jpeg file into an image object in full color (24 bit RGB).

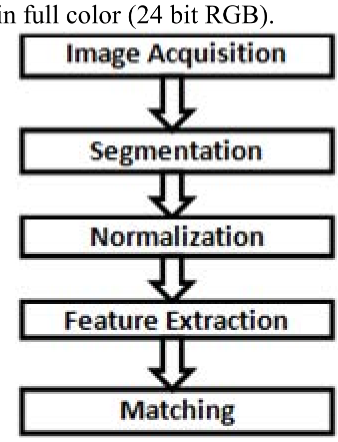

Figure 1: Iris Recognition System

3.2 Segmentation

The main purpose of this process is to locate the iris on the image and isolate it from the rest of the eye image for further processing. Some other important tasks that are also performed in this iris segmentation block include image quality enhancement using histogram equalization and noise reduction using Median Filter [5], which provide excellent noise reduction capabilities and is particularly effective in the presence of salt and pepper noise. To locate the iris from image, the important steps are Pupil Detection and Outer Iris Localization. Well-known methods such as the Integro-Differential Operator, Hough Transform and Active Contour models have been successful techniques in detecting the boundaries. But among all methods, Hough Transform is used for a quick guess of the pupil centre. In this paper we have used the Hough Transformation[6]. The iris inner and outer boundaries are located by finding the edge image using the Canny edge detector [1], then using the Hough transform to find the circles in the edge image. For every edge pixel, the points on the circles surrounding it at different radius are taken, and their weights are increased if they are edge points too, and these weights are added to the accumulator array. Thus, after all radiuses and edge pixels have been searched, the maximum from the accumulator array is used to find the center of the circle and its radius according to the equation.

$$X^2+Y^2=R^2 \qquad \text{----------} \ (1)$$

Where *X, Y* are the center of the circle and *r* is the radius of the circle. The highest two points in the Hough space correspond to the radius and center coordinates of the circle best defined by the edge points.

3.3 Normalization

After the segmentation of required iris region, the next step is to normalize the iris region and to generate the iris code for the same[2]. Since the size of pupil depends on intensity of light and there are variaitions like position of pupil, it is important to normalize the image to get iris texture in a rectangular block of fixed size. Normalization process is used to convert annual region of iris into its polar equivalent.

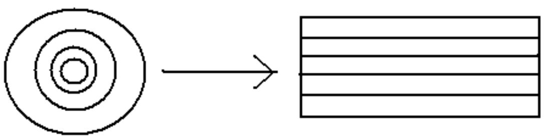

Figure 3: Depicted how Iris Image is converted into Polar Coordinate

Following set of equations is used to transform the annular region of iris into polar equivalent.

$I(x(\rho, \theta), y(\rho, \theta) \Rightarrow I(\rho,\theta)$

With

$xp(\rho,\theta)=xp_0(\theta)+rp*\cos(\theta)$

$yp(\rho,\theta)=yp_0(\theta)+rp*\sin(\theta)$

$xi(\rho,\theta)=xi_0(\theta)+ri*\cos(\theta)$

$yi(\rho,\theta)=yi_0(\theta)+ri*\sin(\theta)$

Where, rp and ri are respectively the radius of pupil and the iris, while $(xp(\theta), yp(\theta))$ and $(xi(\theta), yi(\theta))$ are the coordinates of the pupil and iris boundaries in the direction θ. The value of θ belongs to [0; 360], ρ belongs to [0; 1].

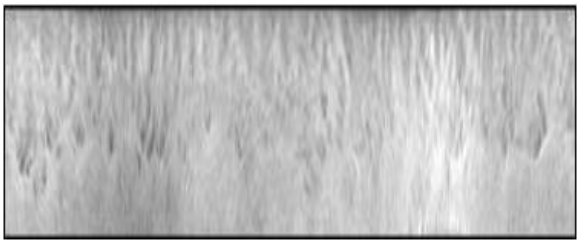

Figure 4: Normalised Image

3.4 Feature Extraction with Local Binary Pattern

LBP is a type of feature extraction techniques[7]. In this method, window is divided into cells. Each pixel of a cell is compared with its eight neighbours. If the value of centre pixel is smaller than neighbourhood pixel then one is assigned for that neighbourhood pixel otherwise zero. The iris code for the centre pixel is obtained by concatenating the eight bits which is converted into decimal. Find the histogram of the frequency of each number occuring over the cell. Feature vector of window is obtained by concatenating histograms of all cells.

3.5 Matching

Matching is done by comparing histograms of two LBP images of respective iris images. One method of comparing two histograms is Chi-square statistics [8]. The dissimilarity between two LBP histograms is evaluated by using formula shown below:

LBP histograms $HA^i(HA^i_{1}, HA^i_{2,\ldots\ldots\ldots}, HA^i_{32})$ and $HB^i(HB^i_{1}, HB^i_{2,\ldots\ldots\ldots}, HB^i_{32})$

$$\chi^2(HA^i,HB^j) = \sum_{k=1}^{32} \frac{(HA^i_k - HB^j_k)^2}{HA^i_k + HB^j_k}$$

Because it is possible that $HA^i + HB^j = 0$, includes non-zero bins. Suppose the LBP features of the two iris images are:

$HA \{ HA^1, HA^2, \ldots, HA^{32}\}$ and $HB \{ HB^1, HB^2, \ldots, HB^{32}\}$ respectively, matching score can be evaluated as:

Set S=0
for i=1 : 32
  compute $\chi^2(HA^i, HB^i)$
  if $\chi^2(HA^i, HB^i) < C_{Th}$
    set Flag=0
    for j=1 : 32
      if $(j \neq i)$
        compute $\chi^2(HA^i, HB^j)$
        if $\chi^2(HA^i, HB^j) < \chi^2(HA^i, HB^i)$
          Flag=1;
          break;
        end
      end
    end
    if Flag=0
      S= S+1
    end
  end
end

Figure 4: Algorithm for Matching

C_{th} is a constant value learned from the training set. The matching score S has the range from 0 to 32, and could be normalized as $S/32$ to obtain a uniform output for fusion. The matching score should be high for two images being from the same eye.

4. Conclusion

This paper has presented an iris recognition system, which was tested using some eye images from CASIA database in order to verify the claimed performance of iris recognition technology. Firstly, an automatic segmentation algorithm was presented, which would localise the iris region from an eye image and isolate eyelid, eyelash and reflection areas.

Automatic segmentation was achieved through the use of the circular Hough transform for localising the iris and pupil regions. Next, the segmented iris region was normalised to eliminate dimensional inconsistencies between iris regions. This was achieved by implementing a version of Daugman's rubber sheet model, where the iris is modelled as a flexible rubber sheet, whichis unwrapped into a rectangular block with constant polar dimensions. Features of the normalised iris image in order to produce a biometric template. Finally, the Chi-Square statistic is used to test the dissimilarity between two LBP histograms of two iris images. If Chi square distance is less than the set threshold value, then the two templates were deemed to have been generated from the same iris.

5. Snapshots

Figure 5: Graphical User Interface

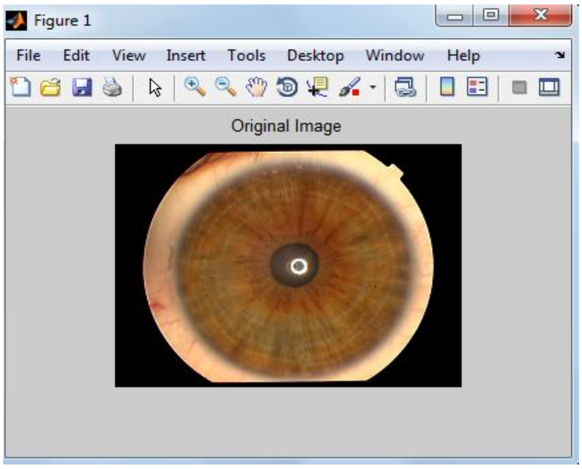

Figure 6: Original Image of an Eye

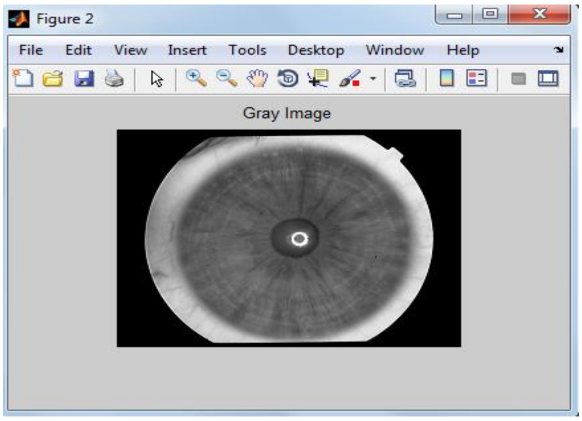

Figure 7: Gray Scale Image of Original Image

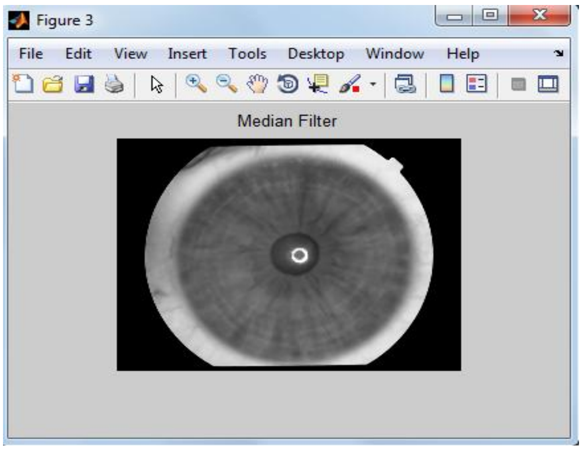

Figure 8: Image after Median Filter

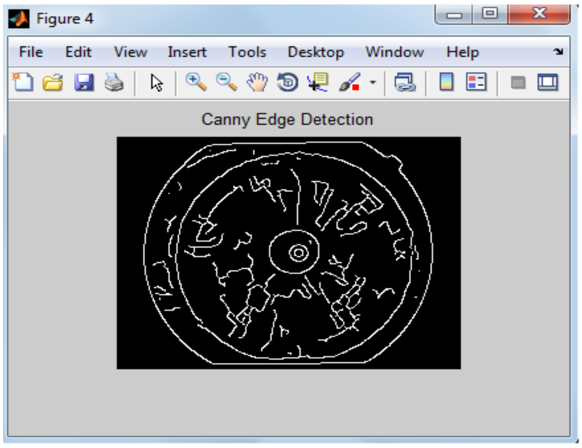

Figure 9: Image After Canny Edge Detection

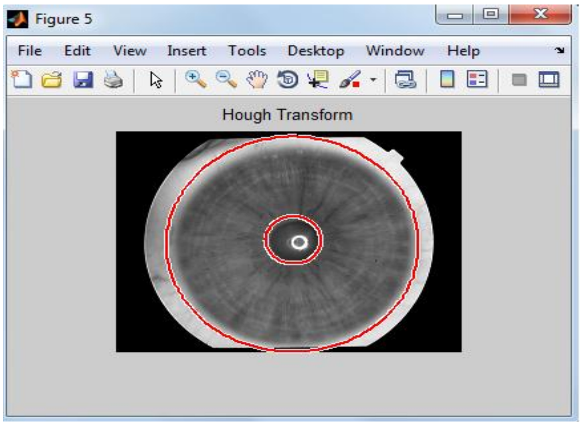

Figure 10: Image After Hough Transformation

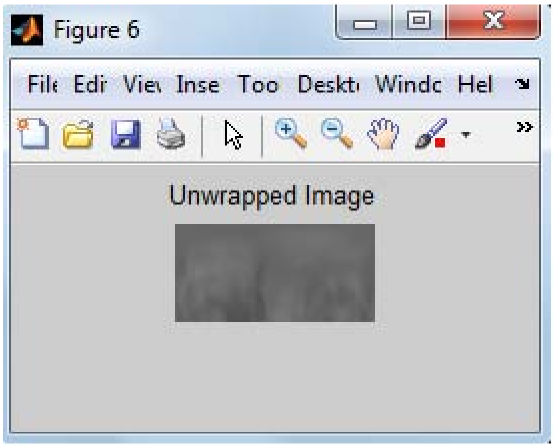

Figure 11: Image After Normalization

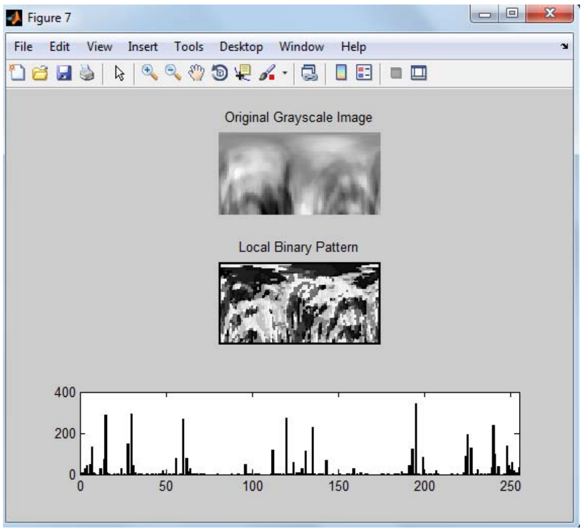

Figure 12: Image After Applying Local Binary Pattern (LBP) method

Figure 13: Registration Screen

Figure 14: Result After Matching

References

[1] CANNY, J. A computational approach to edge detection. Pattern Analysis and Machine Intelligence, IEEE Transactions on, 6 (1986), 679–698.

[2] DAUGMAN, J. How iris recognition works. Circuits and Systems for Video Technology, IEEE Transactions on 14, 1 (2004), 21–30.

[3] DAUGMAN, J. New methods in iris recognition. Systems, Man, and Cybernetics, Part B: Cybernetics, IEEE Transactions on 37, 5 (2007), 1167–1175.
[4] JAIN, A. K., ROSS, A., AND PRABHAKAR, S. An introduction to biometric recognition. Circuits and Systems for Video Technology, IEEETransactions on 14, 1 (2004), 4–20.
[5] PERREAULT, S., AND HÉBERT, P. Median filtering in constant time. Image Processing, IEEE Transactions on 16, 9 (2007), 2389–2394.
[6] RAGHAVENDRA, C. High protection human iris authentication in new atm terminal design using biometrics mechanism. Journal of Global Researchin Computer Science 3, 11 (2012).
[7] RASHAD, M., SHAMS, M., NOMIR, O., AND EL-AWADY, R. Iris recognition based on lbp and combined lvq classifier. International Journalof Computer Science & Information Technology (IJCSIT) Vol 3 (2011).
[8] SUN, Z., TAN, T., AND QIU, X. Graph matching iris image blocks with local binary pattern. In Advances in Biometrics. Springer, 2005, pp. 366–372.
[9] WILDES, R. P. Iris recognition: an emerging biometric technology. *Proceedings of the IEEE 85*, 9 (1997), 1348–1363.