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Iris Recognition using LBP with Classifiers-KNN and NB

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Abstract: ***A biometric system provides special and automatic identification of an individual based on characteristics and unique features showed by individuals. With the need for security system going up, Iris recognition is emerging as one of the important methods of biometrics-based identification system. Our system basically explains the Iris verification that is attempted to implement in MATLAB. Iris recognition is amongst the most robust and accurate biometric technologies supporting databases in excess of millions of peoples. Firstly, preprocessing of iris image includes localization, segmentation and normalization. Canny edge detection is used for region of interest segmentation and localization. For feature extraction Local Binary Pattern (LBP) is used. After feature extraction, Matching is performed by hamming distance. Then, classification is achieved by two different classifiers viz. K-NN and Navie Bayes. The average accuracy of proposed method is which is higher than other conventional methods.***

Keywords: Biometrics, iris recognition, Local Binary Pattern (LBP), iris feature extraction, matching.

1. Introduction

Identification and authentication of any individual is becoming more important in recent days. In the modern world where computers and electronics devices are more extensively used and the population of the world is increasing, there is a need for highly accurate and secured practical authentication technology. Traditional techniques such as user name, passwords, keys, ID cards, hardware token based systems are not reliable and secure in many of the security zones. Thus there is an increasing need for automatic reliable authentication process in modern society. In the recent few years biometric identification has proven to be more reliable means of verifying the human identity. Biometric refers to a science of analyzing human physiological or behavioral characteristics for security purposes and the word is derived from the Greek words bios means life and metrikos means measure. The Biometric characteristics cannot be faked, forged, guessed and stolen easily. One need not remember his/her biometric traits. Biometric identification techniques use inherent physical or behavioral characteristics which are unique among all individuals. The behavioral biometrics are signature, voice, keystroke, gait etc., and physiological biometrics are fingerprint, face, palm print, iris, retina, ear, DNA etc. Summiya Fatima et.al[1],presented among the physiological biometrics, iris is an important feature of the human body and it has the characters of uniqueness and stability. Iris recognition technology is now a day's more advantageous in the field of information security and verification of individuals in the areas such as controlling access to security zones, verification of passengers at airports, stations, computer access at defense establishments, research organization, data base access control in distributed systems etc. Iris recognition systems are currently being deployed in many countries for airline crews, airport staffs, national ID cards and missing children identification etc.

The human iris is a visible color ring bounded by the pupil (the dark opening) and white sclera, as depicted in Fig. 1. The size of the iris varies from person to person with a range of 10.2 to 13.0 mm in diameter, an average size of 12 mm in diameter, and a circumference of 37 mm .

Figure 1: Original Eye Image

The human eye is sensitive to visible light. Increasing illumination on the eye causes the pupil of the eye to contract, while decreasing illumination causes the pupil to dilate. Visible light causes secular reflections inside the iris ring. On the other hand, the human retina is less sensitive to near infra-red (NIR) radiation in the wavelength range from 800 nm to 1400 nm, but iris detail can still be imaged with NIR illumination. As the muscles surrounding a pupil contract or relax, the size of the pupil changes to regulate the amount of light entering into an eyeshows in Figure1. Therefore, illumination variations will cause significant changes in pupil size. In the daily illumination environment, pupil diameter usually varies from 1.5mm to 7mm.As a result, the changes lead to iris deformation dramatically and introduce large intra-class difference. Thus, iris recognition under unrestricted illumination conditions is an extremely challenging problem.

Formation of the iris begins during the third month of embryonic life. The unique pattern on the surface of the iris is formed during the first year of life, and pigmentation of the stoma takes place for the first few years. Formation of the unique patterns of the iris is random and not related to any genetic factors . The only characteristic that is dependent on genetics is the pigmentation of the iris, which determines its color which utilizes Arup Sarmah et.al,[2]. Due to the epigenetic nature of iris patterns, the two eyes of an individual contain completely independent iris patterns, and identical twins possess uncorrelated iris patterns.

Iris recognition system can be used to either Sheeba Jeya Sophia S. et.al,[3],prevent unauthorized access or identity individuals using a facility . When installed ,this requires users to register their irises with the system . A distinct iris code is generated for every iris image enrolled and is saved within the system. Once registered, a user can present his iris to the system and get identified .Iris recognition technology to provide accurate identity authentication without PIN numbers, passwords or cards . Enrollment takes less than 2 minutes. Authentication takes less than 2 seconds.

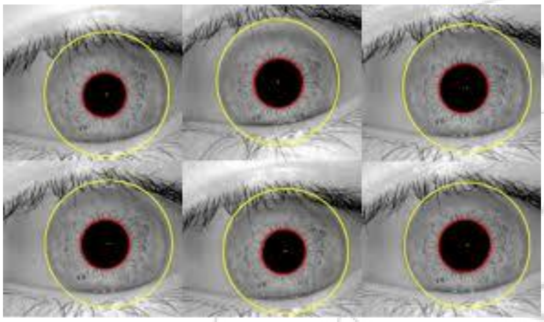


Figure 2: Sample of Iris Images

Iris recognition system is generally includes a series of steps : (i) input image,(ii) iris preprocessing includes localization, segmentation, and normalization,(iii) feature extraction (iv) matching(v) classification as shown in Figure .Input image is to get the feature vector and iris signature used for matching and classification to obtained the recognition rate. In this paper both texture analysis and matching of texture representation will be used with the aid of combined classifier Local Binary Pattern (LBP) and a comparative evaluation with other methods using different iris datasets shown in Figure (2). M. Suganthy et.al presented formation of the iris begins during the third month of embryonic life . The unique pattern on the surface of the iris is formed during the first year of life, and pigmentation of the stroma takes place for the first few years. Formation of the unique patterns of the iris is random and not related to any genetic factors[4]. The only characteristic that is dependent on genetics is the pigmentation of the iris, which determines its color. Due to the epigenetic nature of iris patterns, the two eyes of an individual contain completely independent iris patterns, and identical twins possess uncorrelated iris patterns.

Iris Verification and Recognition The iris is an externally visible, yet protected organ whose unique epigenetic pattern remains stable throughout adult life. These characteristics make it very attractive for use as a biometric for identifying individuals. Image processing techniques can be employed to extract the unique iris pattern from a digitized image of the eye, and encode it into a biometric template, which can be stored in a database. This biometric template contains an objective mathematical representation of the unique information stored in the iris, and allows comparisons to be made between templates. When a subject wishes to be identified by iris recognition system, their eye is first photographed, and then a template created for their iris region. This template is then compared with the other templates stored in a database until either a matching template is found and the subject is verified, or no match is found and the subject remains unverified. Compared with other biometric technologies, such as face, speech and finger recognition, iris recognition can easily be considered as the most reliable form of biometric technology. However, there have been no independent trials of the technology, and source code for systems is not available. Also, there is a lack of publicly available datasets for testing and research, and the test results published have usually been produced using carefully imaged irises under favorable conditions.

2. Related Work

Iris Code developed in 1993 and continuously improved by Daugman [5,6,7,8]. From An iris code Analysis.LBP texture analysis [9,10]operator is defined as a gray scale invariant texture measure derived from a general definition of texture in a local neighbourhood. The average of the gray levels below the center pixel is subtracted from that of the gray levels above center pixel. The LBP operator [11,12] has been regarded as one of the best descriptors for the appearance of local facial regions [13] and it has been widely used in various application areas, including the face and iris recognition [14, 15].

Though the sign component of LBP operator preserves most of the information of local difference, the magnitude component provides additional discriminant information that enhances the overall recognition accuracy. In general, there are many properties that make an iris ideal biometric method ,the first is the uniqueness features," no two iris are the same" even between the left and right eye for the same person. Then the accuracy results from an iris pattern which is unchanged through a person's life with the data reach physical structure. Savitri et al.[16] applied the Gabor wavelet ,local binary pattern (LBP)and histogram of oriented gradient (HOG) techniques to extract features on specific portion of the iris to show that half portion of the iris is enough for iris recognition instead of entire image.LBP can solve iris feature extraction according the inherent intensity -related texture problem ,to some illumination and interference and has potential for pattern recognition[17].

3. Methodology

Localization of Iris with Canny Edge Detection technique used for segmentation and it is implemented using image. Here, after getting the input image, the next step is to localize the circular edge in the region of interest. Canny edge detection operator uses a multi-stage algorithm to detect a wide range of edges in images. It is an optimal edge detector with good detection, good localization and minimal response. In localization we used this detection, in which the inner and outer circles of the iris is approximated, in which inner circle corresponds to iris/pupil boundary and outer circle corresponds to iris/sclera boundary. But the two circles are usually not concentric. Also, comparing with other parts of the eye, the pupil is much darker. The inner boundary is detected between the pupil and the iris. At the same time, the outer boundary of the iris is more difficult to detect because of the low contrast between the two sides of the boundary. So, we detect the outer boundary by maximizing changes of the perimeter normalised along the circle.

Iris segmentation is an essential process which localizes the correct iris region in an eye image. Circular edge detection function is used for detecting iris as the boundary is circular and darker than the surrounding. Pupil position can be estimated easily because of the lower grey level in pupil region and then iris boundary localization speed can be improved based on pupil position localization.

Feature Extraction with Local Binary Pattern: Local binary (LBP) is a type of feature used for classification LBP was first described in 1994. It has since been found to be a powerful feature for texture classification; it has further been determined that when LBP is combined with Histogram of oriented gradients (HOG) classifier, it improves the detection performance considerably on some datasets shown in Figure(3).

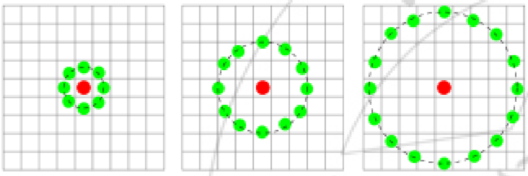


Figure 3: Three neighborhood examples used to define a texture and calculate a local binary pattern (LBP).

LBP describes the qualitative intensity

Concept of LBP: The LBP feature vector, in its simplest form, is created in the following manner: i. Divide the examined window to cells (e.g. 16x16 pixels for each cell). ii. For each pixel in a cell, compare the pixel to each of its 8 neighbors (on its left-top, left-middle, left-bottom, right-top, etc.). Follow the pixels along a circle, i.e. clockwise or counter-clockwise. iii. Where the center pixel's value is greater than the neighbor, write "1". Otherwise, write "0". This gives an 8-digit binary number (which is usually converted to decimal for convenience). iv. Compute the histogram, over the cell, of the frequency of each "number" occurring (i.e., each combination of which pixels are smaller and which are greater than the center). v. Optionally normalize the histogram. vi. Concatenate normalized histograms of all cells. This gives the feature vector for the window.

Here, features of iris textures are extracted using Local Binary Patterns (LBP). LBP operator forms labels for the image pixels by thresholding the neighborhood of each pixel and considering the result as a binary number[18]. LBP provides fast feature extraction and texture classification. Due to its discriminative power and computational simplicity, the LBP texture operator has become a popular approach in various applications like image retrieval, remote sensing, biomedical image analysis, motion analysis etc…. to extract the entire iris template features. Here, LBP is used to extract the features of the normalized iris image.

Since LBP method is working on a grayscale level so colored images should be transformed into a grayscale level. The proposed system gives a high recognition rate on different iris datasets compared with other methods[19]. The LBP operator is used to elicit the iris features. The traditional LBP code is computed by comparing a pixel of an image with its neighboring pixels[20,21] .

Local Binary Pattern (LBP) is an efficient method, used for feature extraction and texture classification. It was first introduced by Ojala et al in 1996 [22] , this was the first article to describe LBP. The LBP operator was introduced as a complementary measure for local image contrast and it was developed as a grayscale invariant pattern measure adding complementary information to the “amount” of texture in images. The LBP operator is used to elicit the iris features. The traditional LBP code is computed by comparing a pixel of an image with its neighboring pixels[23,24]. LBP is ideally suited for applications requiring fast feature extraction and texture classification. Due to its discriminative power and computational simplicity, the LBP texture operator has become a popular approach in various applications including visual inspection, image retrieval, remote sensing, biomedical image analysis, motion analysis, environmental modeling, and outdoor scene analysis. G. Savithiri and A. Muurugan [25], presents LBP and Histogram of Oriented Gradients in order to extract the entire iris template features, they used hamming distance for matching. In this paper LBP is introduced in order to extract the iris features from the normalized iris image. Local Binary Pattern (LBP) is an easy-to-compute, robust local texture descriptor, and it has been shown to be promising in the computer vision field, including industrial inspection, motion analysis, and face recognition[26]. In this paper, they show that LBP can solve iris feature extraction according the inherent intensity-related texture problem, is robust to some illumination and interference, and has potential for pattern recognitions[27,28]. This method also used in recent work. Zhenan Sun et al.[29], LBP describes the qualitative intensity relationship between a pixel and its neighbourhoods which is robust, discriminant and computationally efficient so it is well suited to texture analysis.

LBP is a grayscale invariant local texture operator with powerful discrimination and low computational complexity. An LBP operator thresholds a neighbourhood by the gray value its center (g_c) and represents the result as a binary code that describes the local texture pattern. The operator ($LBP_{P,R}$) is derived based on symmetric neighbour set of P members $g_{p(p=....,p-1)}$ within a circular radius of R.

$$LBPp,R \;\; = \sum_{p=0}^{p-1} s(gp - gc)2^p$$

s(x)={1,x>0

0,x<0

K-NN Classifier:-

K-Nearest Neighbour classification algorithm is widely applied in pattern recognition and data mining for classification[2].

d = dimensional train data set

q_i = query data

p_i = test point data

$$d(p,q)=\sqrt{\sum_{i=1}^{n}(qi - pi)}$$

Naïve Bayesian Classifier:

It is based on the Bayesian theorem It is particularly suited when the dimensionality of the inputs is high. Parameter estimation for Naive Bayes models uses the method of maximum likelihood. In spite over-simplified assumptions, it often performs better in many complex real world situations. Hong Choon Ong et.al[30], Requires a small amount of training data to estimate the parameters. Define the A as the observed attribute values and the C is as a class of attributes. The probabilities calculated as,

$P(C = c/ A=a)$,

When attributes $A_1, A_2 ..... A_n$ are conditionally independent of each other given the class, then probability is proportional to:

$P(C =c)\ \Pi^n_{i=1} P(A_i =a_i \text{ l } C=c)$

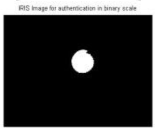
Algorithm for proposed method

StepI:-Input image.

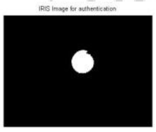
Step II: Image Preprocessing

i)Image converted into gray scale image

ii)Gray scale image is converted into binary image.



iii)Binary image is segmented for locating iris circles.



iv) Segmented image is localized for for finding radius and center point.

StepIII:-Feature extraction

Feature extracted using LBP.

StepIV:-Classifier

Classifies by KNN and NB.

StepV:- Result.

4. Result

Training of first 3 images for each eye of every person available in MMU database is provided to MATLAB program.

Sr. No.	Images under testing of each subject	Nos. of images under testing	Accuracy using KNN (in %)	Accuracy using NB (in %)
1	3:1:5	3 11100	100.00000	94.186047
2	3:1:6	4 11110	96.279300	89.244186
3	3:1:7	5 11111	93.953488	87.209302
4	4:1:6	3 01110	94.961240	88.372093
5	4:1:7	4 01111	92.441860	86.046512
6	5:1:7	3 00111	89.922481	83.720930
7	6:1:7	2 00011	84.883721	76.744186

5. Conclusion

A efficient algorithm for iris recognition using LBP feature extraction has been developed. Also, we have used and compared two different classification viz. KNN and Navie Bayes (NB) methods. From results, it is concluded that KNN classification is more reliable for obtaining accurate results as compared to NB method.

6. Future Scope

Accuracy observed from results is declining with the images under testing which are different than training images. We can expect to improve the system performance by increasing number of sample images for training so that matching of feature extraction will be more accurately possible. This system can be used with hardware for realtime iris recognition.

References

[1] Summiya Fatima,Richa Golash,"An Efficient method for Deformed Iris Recognition by Extracting Hybrid Features",Department of ECE ,AIT Tumkur,India.vol 3,Issue 4,2014.

[2] Arup Sarmah,Chandan Jyoti Kumar,"Iris Verification Using Legendre Moments and KNN Classifier"vol.2,Issue 8,pp 52-59,2013.

[3] Sheeba Jeya Sophia S. and Veluchamy S."Security System Based on Iris Recognition"Reserch journal of Engineering Sciences,vol2(3),16-21,2013

[4] M.Suganthy,P.Ramamoorthy,R.Krishnamoorthy, "Effective Iris Recognition For Security enhancement""International Journal of Engineering Research and application, vol.2, Issue2, pp.1016-1019,.2012.

[5] J.G. Daugman, High confidence visual recognition of persons by a test of statistical independence", IEEE Trans.Pattern Anal.Mach. Intell, vol.15,no.11,pp.1148-1161,1993.

[6] J.Daugman ,"How is iris recognition work",IEEE Trans. Comput.,syst.,Video Technol., vol.14,no.1,pp.21-30,2004.

[7] J.G.Daugman,"Probing the uniqueness and randomness of IrisCode:Results from 200 billion iris pair comparisons,"Proc. IEEE,vol94,2006.
[8] J.Daugman,"New methods in iris recognition",IEEETrans.Syst.,Man,Cybern.B,vol.37,no. 5,pp.1167-1175,2007.
[9] Dolly Choudary,Shamik Tiwari ,Ajay kumar Singh," A Survey: Feature Extraction Methods for Iris Recognition". International Journal of Electronic Communication & Computer Technology(IJECCT) Volume 2 Issue 6,pp275-279,2012.
[10] V Patil, K. C. Jondhale (2009)," Content Based Image Retreival Based on Phase Congruency Via Log Gabor Wavelet Filters", Proceedings of ICCVGIVP Nagpur, pp 84-85,2009.
[11] Ojala, M. Pietikäinen, and T. Mäenpää, "Multire solution gray-scale and rotation invariant texture classification with local binary pattern" ,IEEE Trans. on Pattern Analysis and Machine Intelligence, vol. 24, pp. 971-987, 2002.
[12] H. Guo, D. Zhang, and D. Zhang, "A completed modeling of local binary pattern operator for texture classification", IEEE Trans. on Image Processing, vol. 19, pp. 1657-1663, 2010.
[13] Maturana, D. Mery, and A. Soto, "Face recognition with local binary patterns, spatial pyramid histograms and naive bayes nearest neighbor classification," in Proc. Int. Conf. the Chilean Comp. Science Society, pp. 125-132,2009.
[14] N. Sun, T. N. Tan, and X. C. Qiu, "Graph matching iris image blocks with local binary pattern," in Proc. Int. Conf. Advances on Biometrics, pp. 366-372,2005.
[15] Q. He, G. Q. Feng, Y. S. Hou, L. Li, and E. Micheli-Tzanakou, "Iris feature extraction method based on LBP and chunked encoding" in Proc. 2011Int. Conf. Natural Computation, pp. 1663–1667.2011.
[16] Savitri and A. Murugan ,"Performance analysis of half iris feature extraction using GW, LBP and HOG", Intelligent J. Computer Applications 22,27-32,2011.
[17] W.W. Boles and B.Boashash," A human identification technique using images of the iris and wevelet transform ", IEEE Transactions on Signal processing ,1998,46(2), 1185-1188.
[18] J. Daugman, "How iris recognition works", Proceedings of 2002 International Conference on Image Processing. 1, 2002.
[19] "Iris feture Extraction and Recognition based on different transforms"International Journal of Advances in science Engineering and Technology",ISSN:2321-9009,volume -1,Issue-2,oct-2013.
[20] T. Ojala, M. Pietikäinen, and T. Mäenpää, "Multire solution gray-scale and rotation invariant texture classification with local binary pattern," IEEE Trans. on Pattern Analysis and Machine Intelligence, vol. 24, pp. 971-987, 2002.
[21] Z. H. Guo, D. Zhang, and D. Zhang, "A completed modeling of local binary pattern operator for texture classification," IEEE Trans. on Image Processing, vol. 19, pp. 1657-1663, 2010.
[22] T. Ojala, M. Pietikäinen , and D. Harwood, "A Comparative Study of Texture Measures with Classification Based on Feature Distributions", Pattern Recognition, vol. 29, pp.51-59, 1996.
[23] G. Savithiri and A. Muurugan, "Performance Analysis on Half Iris Features Extraction Using GW, LBP, and HOG", International Journal of Computer Applications, Vol. 22, No. 2 , pp. 2732 , 2011.
[24] Qichuan Tian, Hua Qu, Lanfang Zhang and Ruishan Zong," Personal Identity Recognition Approach Based on Iris Pattern", State of the art in Biometrics, Dr. Jucheng Yang (Ed.), ISBN: 978-953-307-489-4,2011.
[25] W.W.Boles and B.Boashash,"A human identification technique using images of the iris and wavelet transform, IEEE Classification",Transactions on Signal Processing, 46(4), 1185-1188,1998.
[26] Shu-Ren Zhou, Jian -Ping Yin ,Jian -Ming Zhang ,"Local binary pattern (LBP) and local phase quantization (LBQ)based on gabor filter for face representation ", Nrurocomputing , Vol.116,pp.260-264,2013.
[27] Hamouchene I.Aouat S, LAcheheb H."New segmentation archoitecture for texture matching using the LBP method ",IEEEtechnically Co-sponsored SAI Conference ,London UK,2013.
[28] Topi Maenpaa, Matti Pietikainen,"Texture analysis with local binary patterns",chapter1,inC.Chen and P.Wang Handbook of pattern Recognition and Computer Vision ,3rd ed,Word Scientific ,pp.197-216,2005.
[29] Zhenan Sun,Teiniu Tan and Xianchao Qiu,"Graph Matching Iris image Blocks with Local Binary Pattern",Center for Biomatric and Sequrity Research,pp366-372.2005.
[30] Hong Choon Ong,May Yee Khoo and Siew Lin Saw,"An Improvement on the Naivey Bayes Classifier",International Conferance on Information and Knowledge Manegement Singapore IPCSIT vol.45, pp.190-194, 2012.

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