Identify a person from Iris Pattern using GLCM features and Machine Learning Techniques

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Abstract:

In today's era, when we see a pandemic like a corona, we can understand the need for nonimpact biometric feature matching techniques. Iris recognition is one of the accurate biometric features that can be used to identify a person. Iris recognition, as an emerging biometric recognition approach, is becoming an active topic in both research and practical applications; Iris recognition is recognizing an individual by analyzing the apparent pattern of his or her iris. A typical iris recognition system includes iris imaging, iris detection, feature extraction, and recognition. Here, we are proposing a straightforward approach for segmenting the iris patterns using a global thresholding technique. After this step, we get the iris' pupil, which is subtracted from the original image to urge the iris part. Then GLCM features are extracted from the iris, and machine learning techniques will do training and testing. We plan to perform Experiments using iris images obtained from the CASIA database. The general accuracy we get is promising, with near about 99% on using a support vector machine classifier.

Keywords*: Iris detection, machine learning techniques, CASIA dataset, GLCM features.*

I. INTRODUCTION

The iris may be a thin circular structure within the eye. The iris's function is to regulate the pupils' diameter and size. Hence it controls the quantity of sunshine that progresses to the retina. It's a skinny, circular structure within the eye, see figure 1.

It controls the diameter and size of the pupils. The eye color is the color of the iris. In humans, the iris may look green, blue, brown, hazel (a combination of sunshine brown, green, and gold), grey, violet, or maybe pink. In response to the quantity of sunshine exiting the attention, muscles attached to the iris expand or contract the pupil. The larger the pupil, the more light can enter the attention and reach the retina. To regulate the quantity of sunshine entering the watch, the iris (sphincter and dilator) muscles either expand or contract the center aperture of the iris, referred to as the pupil. The iris consists of two layers: the pigmented front fibrovascular called stroma, and beneath it are the pigmented epithelial cells [3]. The iris begins to make within the third month of gestation, and therefore the structures creating its pattern are largely complete by the eighth month. However, pigment accretion can continue into the primary postnatal years [9-12].

Additionally, the iris is well shielded from the environment. It's the foremost individual quality of the physical body. No two irises are alike, not even among twins [1,13]. In fact, the left and right irises of 1 individual aren't identical. The statistical probability that two irises are never precisely the same is estimated at 1 in 1072; Iris recognition is statistically more accurate than DNA testing [7]. For all of those reasons, iris patterns become interesting as an alternate approach to reliable visual recognition of persons when imaging is often done at distances of but a meter, and particularly when there's a requirement to look very large databases without incurring any false matches despite an enormous number of possibilities.

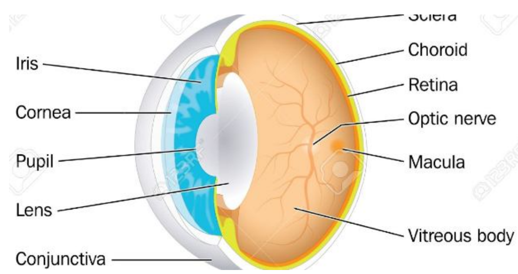

Figure 1 Human eye structure

Here in this paper, section 1 contains the introduction of iris and about why iris recognition is better than the impact recognition system. The second section contains the literature survey about how the researcher works for better recognition of human iris and what are the new techniques now applied in order to increase the accuracy of identification. The third section contains the methodology we have adopted in this paper, and the 4th section contains the results obtained after applying machine learning techniques in iris recognition and its analysis. Finally, all the findings are summarized in the last section concludes.

II. LITERATURE SURVEY

Daugman [4] proposes an Iris location framework by utilizing the Gabor wavelet and example acknowledgment strategy. At the same time, testing this technique on different iris designs has been discovered astounding in execution. At that point, a similar creator proposes another upgrade in his current work, where he suggested that the human irs can likewise be distinguished in the swarm. During this paper, he proposes numerous statically calculations[5]. Proenca H. proposes an expansion to Daugman's work where he proposed an absolutely novel technique which can be executed in a biometric framework and recommended that the iris example of each human is not quite the same as others, so it is regularly spared in the gadget at that point are frequently utilized for coordinating or confirmation reason later[6]. Yu Chen [7] introduced an exceptionally productive strategy for acknowledgment of an individual utilizing biometric highlights. They utilize a remarkable division method for iris division and furthermore novel methodology for preprocessing of pictures, which may lessen the impact of commotion from condition and impact on account of the separation of the camera and its position. Mohamed et al. [8] propose a trading method for iris acknowledgment. In his paper, he recommended the utilization of iris confinement and morphological highlights. For restriction highlights, he utilized shrewd edge location calculation, and for morphological highlights, he separated limit highlights, region, opening and closing, and so on. Mabrukar et al. [9] utilize a totally exceptional technique to perform limitations. To understand the correct iris division, they previously applied the Sobel edge discovery strategy to get limits of iris, at that point, first request subordinate utilized for confinement, at last, hough change is utilized to recognize the situation of focus of student and furthermore to anticipate the range of the understudy circle. Ajay Kumar et al. [11] propose the use of a scanty framework to separate the highlights of iris design. To play out this errand, they first partition the photos into little fixes of 10*10 pixels at that point apply include extraction and confinement, to expand the possibility of recovering the division of information picture. Shikre et al. [13] introduced a 2 level wavelet change to recognize the iris of humans from a self-made dataset. They utilized a complex wavelet change procedure upheld the wavelet tree. This strategy gives great pre handling and definite division of picture. They applied this strategy to the generally utilized dataset of CASIA. Chun-Wei Tan and Ajay Kumar[14] proposes a particular methodology for highlight extraction from iris pictures utilizing resulting measures for iris picture clearness. This strategy utilizes a truly effective pre-handling method, which may perform better in loud conditions too. They proposed the usage of this technique for input iris pictures, which are caught in the presence of commotion. Another creator proposes the use of quick Fourier change and for iris include extraction and pre handling. A particular iris examination technique has been proposed by Jain et al. [15], which utilizes the Hough change and DWT for highlight extraction and coordinating. Here, Fourier change is utilized to perform pre handling on the iris picture, and Hough change is utilized to perform impeccable division and have an extraction of the iris picture. Puhan et al. [16] has proposed the usage of double guides. The double guides are produced from into dark or shading iris pictures subsequent to performing division. The twofold guides are helpful to downsize the prominence time, and furthermore needs less memory. They propose the usage of hough change for iris limitation and to impeccably recognize the round ring of iris. Liu et al. [17] utilize the thresholding method to isolate the locale of intrigue; they utilized a delicate thresholding strategy for the division. Li et al. [18] proposed the use of the Adaboost technique to administrator discovery of limits of an eye and furthermore limit of iris design; they got great outcomes in contrast with thresholding approaches. Uhi and Wild [19] utilize weighted versatile Hough changes in situ of convention Hough change in order to expand the confinement precision. He et al. [20] utilize some pre-preparing channels and histogram balance based methodologies for clamor expulsion. Liu et al. [21] introduced a mixture model upheld integrodifferential allegorical bend administrator and a RANSAC-like calculation for eyelid location.

III. METHODOLOGY

An iris detection and recognition system which is adopted in here can be comprised of the following steps:

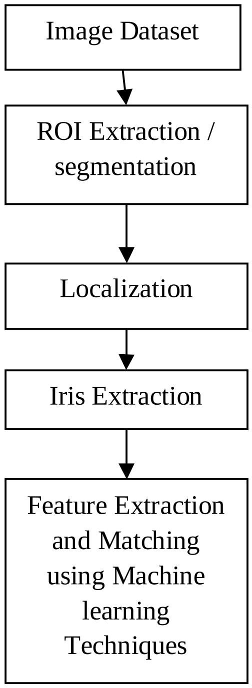

Figure 2 Iris Detection Methodology

A. Image Dataset: Input image also can be taken directly from any data input device like a camera or an integrated device, but most of the researchers used online verified datasets like CASIA, UCI dataset, and datasets online shared by various universities and IITS like IIT Delhi, etc. another freely available datasets are MMU, Bath, UPOL, and UBIRIS [11, 12, 13].

B. Pre Processing**:** Image enhancement The previous image must reduce the effect of non-uniform distortion and illumination. Additionally, it must make the feel more precise and clearer. Then the iris texture is going to be ready to extract the info, which is important for comparison. Histogram equalization is employed for preprocessing. It's the ultimate step for image analysis, and it's important to equalize the values of the previous texture image, and therefore the output image will contain a consistent distribution of intensities. See Figure 3.

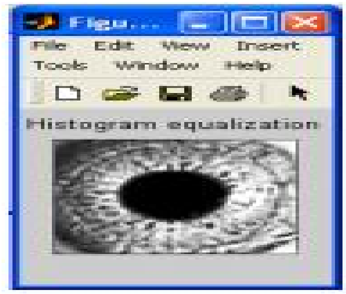

Figure 3 Histogram equalization image [2]

C. ROI Extraction and Segmentation**:** various segmentation techniques are wont to get the right region of interest. Perfect RIO extraction places a really important role in the detection of the iris because the accuracy of subsequent steps depends on the ROI region. Here we are using hough transformation. When hough transform applied to extract the segmented region, then we'd like noise removal filters also because Hough transform couldn't perform well in the presence of noise.

D. Iris Localization: Hough transform is the most generally used algorithm that perfectly identifies the boundaries of iris. Finally, a circular Hough transform was proposed by many other authors so as to extend the localization accuracy. Circular Hough transform has very complex steps and heavy computations. Computations in hough transform wiped out three steps. First, random point (x,y) identifies within the image, then it identifies every possible circle browsing points (x,y), and a new matrix of (a,b,r) is made, where a and b are the coordinates of the middle of the circle.

E. Iris Extraction and Matching**:** iris is the portion between the pupil and outer layer of the human eye. So, to extract the iris portion, we'd like to subtract the pupil from the input image and that we got to remove the outer layer information by using segmentation and localization techniques. The pupil is that the private circle in the eye image and the next outer circle contains iris patterns, whereas the outermost circle contains the segmented eye image. To urge the iris from the segmented image, we'd like to subtract the pupil circle from the input image.

F. Feature Extraction

Haar Features: Here, we are extracting not only Haar transform-based features but also GLCM based texture features and color features.

The image is decomposed to approximate components and detail components by using 2-D scale function, and

2-D wavelet function, the size function and therefore, the wavelet function is defined as follows:

$$\emptyset_{yj,m,n^1}(x,y) = 2^{j/2}\,\emptyset(2^j x - m, 2^j y - n \quad (1)$$

$$\varphi^i x_{\,j,m,n^1}(x,y) = 2^{\frac{j}{2}}{}_{\varphi}(2^j x - m, 2^j y - n),$$

$$i = \{H, V, D\} \qquad (2)$$

Where, ώ(x,y) denotes the wavelet function

GLCM Feature Extraction: The gray level co-occurrence matrix (GLCM) procedure is utilized, and the standardized picture isn't changed over into a twofold structure. The proposed GLCM calculation works by framing a "5x5" recognition window on each testing and preparing standardized iris pictures that look over them. This chose window has a proper size to make putting away and recovering cycles more productive. The calculation will rely upon the direction point to depict an iris picture through GLCM. It begins in the upper left corner with the edge "ɵ." In the wake of figuring the co-event grids, just one of the second-request measurable highlights known as "contrast" will be registered by implication dependent on these produced frameworks.

IV. RESULTS AND DISCUSSION

Here, in the segmentation process, we have used many values of the threshold from 0 to 1, and these threshold values are repeated over the image dataset. So, we can easily identify the best threshold for our dataset. Figure 4 shows the output of the segmentation process.

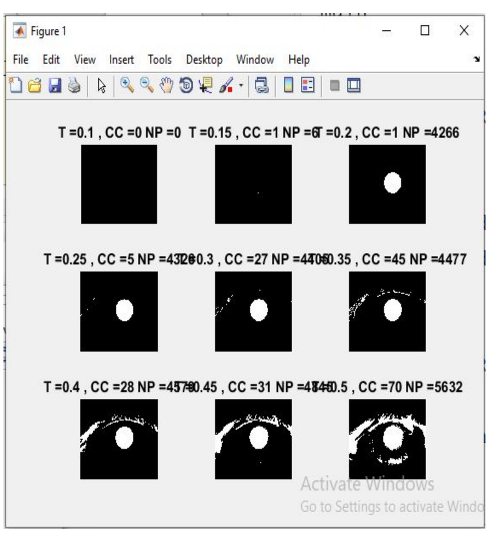

Figure 4 Segmentation of iris image

After finding out the perfect pupil circle, we have gone to locate the center of the circle and also find out the radius of the circle. Then this circle has been drawn on the eye image to locate the position of the pupil as shown in figure 5

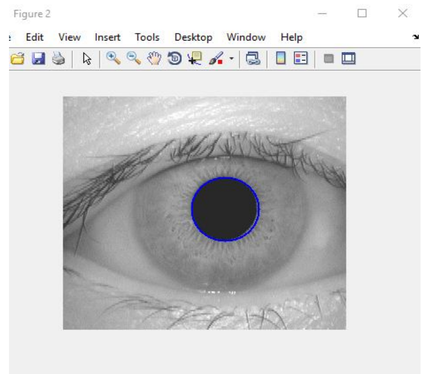

Figure 5 Pupil Position Identification

The operator assumes the pupil and limbus region to be circular contours, and it performs circular edge detection. The upper and lower eyelids are also detected using the Integro-differential 16 operator by changing the contour search to a designed arcuate from circular. We are converting circular iris to the rectangular sheet. This makes easy feature extraction, as shown in figure 6.

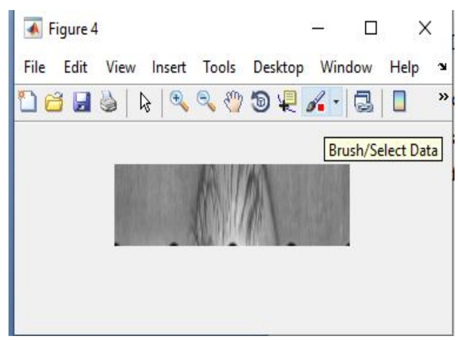

Figure 6 Daugman's Rubber Sheet Model

we had eye pictures of 500 individuals. For preparing the model, we took 5 pictures of every individual, and the rest of the pictures were saved aside for testing the classifier. For preparing, we utilized a 5-overlay cross approval strategy with the goal that each picture in the preparation set can be tried once against the others. We attempted a few classifiers and among them uphold vector machines, nearest neighbor, straight discriminants, and so forth demonstrated incredible guarantee. For preparing and testing, a few classifiers were utilized. Beginning from choice trees, discriminant examination, uphold vector machines, RUSBoosted trees, K-closest neighbors, Subspace KNN and so on. The accompanying table sums up the best-performed classifier exactness.

Table 1 Results of different classifiers

Classifier	Cross validation	Accuracy(in %)
SVM	5	99.0
K Nearest	5	98.5
Decision Tree	5	98.0
Bayes	5	96.0
SVM	10	99.0
K Nearest	10	97.0
Decision Tree	10	97.0
Bayes	10	95.5

Table 1 comprised the results of different classifiers when they applied to the features matrix extracted from our iris dataset by using cross 10 validation. The same is graphically represented in figure 7.

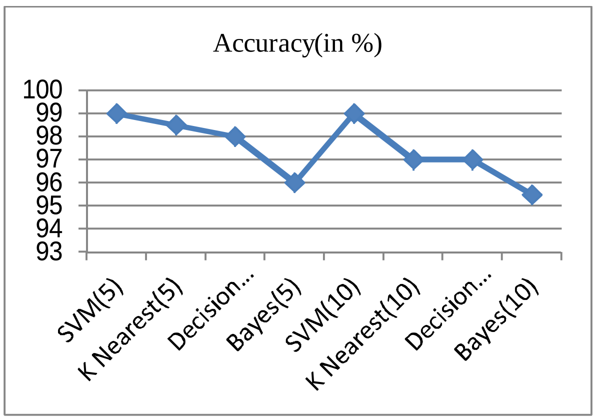

Figure 7 Accuracy of Classification

V. CONCLUSION

Here, a machine learning-based approach to iris recognition from the CASIA image dataset is proposed. With the results above, this thesis successfully showed that just in the case of color spectrum iris images, the machine learning techniques are equally nearly as good because the other ones, in some cases, even better. Still, accuracy is often further improved. And in our findings, accuracy largely depends on accurate segmentation. So some robust approaches could also be taken to enhance the segmentation result. In our approach, we tried to stay to some basic segmentation approaches. This was done keeping in mind their easy implementation. The SVM classifier shows a really good performance of classification with 99% accuracy.

REFERENCES

[1] Shaabad A.Sahmoud and Ibrahim S. Abuhaiba, "*Efficient iris segmentation method in unconstrained environments*," Pattern Recognition, vol.46, no.12, pp. 3174-3185, 2013.

[2] John Daugman, "*Statistical richness of visual phase information: update on recognizing persons by iris patterns*," International Journal of Computer Vision, vol. 45, no.1, pp.25-38, 2001.

[3] Leonard Flom and Aran Safir, "*Iris recognition system,*" U. S. Patent 4641349, 1987.

[4] Daugman J., "*Recognizing persons by their iris patterns*", Proc. Advances in Biometric Person Authentication, Vol. 3338, pp. 5 - 25,2004.

[5] Daugman J., "*The importance of being random: statistical principles of iris recognition*", Proc. Pattern Recognit., Vol. 36, pp. 279 – 291, 2003.

[6] Proenca H., "*An iris recognition approach through structural pattern analysis methods*", Expert Systems, Vol. 27, No. 1, pp. 6 - 16, 2010.

[7] Yu Chen, "*A high efficient biometrics approach for unconstrained iris segmentation and recognition*", Ph.D. Thesis, College of Engineering and Computing, Florida International University, 2010.

[8] M. A. Mohamed, M. A. Abou-El-Soud and M. M. Eid, "*Automated Algorithm for Iris Detection and Code Generation*," 2009.

[9] S. S. Mabruka, N. S. Sonawane and J. A., "*Biometric System using Iris Recognition*," International Journal of Innovative Technology and Exploring Engineering, vol. 2, no. 5, 2013.

[10] M. Pradhan, "*Next Generation Secure Computing: Biometric in Secure E-transaction*," International Journal of Advance Research in Computer Science and Management Studies, vol. 3, no. 4, pp. 473-489, 2015.

[11] Ajay Kumar, Tak-Shing Chan, Chun-Wei, Tan,"*Human Identification from at-a-distance Face Images using Sparse Representation of Local Iris Features,*"978-1-4673-0397- 2/12/$31.00@2012 IEEE.

[12] iris image dataset https://en.wikipedia.org/wiki/Iris_recognition seen on 12Jan 2020.

[13] Shirke, Swati D., and C. RajaBhushnam. "*Review of IRIS recognition techniques*." 2017 International Conference on Algorithms, Methodology, Models and Applications in Emerging Technologies (ICAMMAET). IEEE, 2017.

[14] Chun-Wei Tan,Ajay Kumar," *Accurate Iris Recognition at a Distance Using Stabilized Iris Encoding and Zernike Moments Phase Features*", IEEE Trans.on Image Processing,Vol-23,no 9,Sept. 2014.

[15] B. Jain, Dr.M.K.Gupta and Prof.JyotiBharti, "*Efficient Iris recognition algorithm using Method of Moments*," in International Journal of Artificial Intelligence & Applications, 2012.

[16] N. Puhan, N. Sudha, H. Xia and X. Jiang, "*Iris recognition on edge maps*," in IET Computer Vision, 2007.

[17] Liu, X., Bowyer, K., Flynn, P.: "*Experiments with an improved iris segmentation algorithm*". In: IEEE Workshop on Automatic Identification Advanced Technologies (2005)

[18] Li, H., Sun, Z., Tan, T.: "*Robust iris segmentation based on learned boundary detectors*". In: International Conference on Biometrics (2012)

[19] Uhl, A., Wild, P.: "*Weighted adaptive hough and ellipsopolar transforms for realtime iris segmentation.*" In: International Conference on Biometrics (2012)

[20] He, Z., Tan, T., Sun, Z., Qiu, X.: "*Toward accurate and fast iris segmentation for iris biometrics*." IEEE TPAMI 31(9), 1670–1684 (2009)

[21] Liu, X., Li, P., Song, Q.: "*Eyelid localization in iris images captured in less constrained environment. In: Tistarelli, M., Nixon, M.S. (eds.)*" ICB 2009. LNCS, vol. 5558, pp. 1140–1149. Springer, Heidelberg (2009).

[22] Shakti Chourasiya, Suvrat Jain, "*A Study Review On Supervised Machine Learning Algorithms*" SSRG International Journal of Computer Science and Engineering 6.8 (2019): 16-20.