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Extraction of Iris Crypt, Pigment Spot, and Wolfflin Nodule Biological Feature using Feature Point Selection Algorithms

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Abstract: ***The iris biometrics is an important biological feature of the human. The iris is the part of human eye. The human eye consists of many features. Iris is one of the unique features of human eye. In this paper we propose an algorithm to extract the features of iris. The existing algorithms are based on combined biological features of iris. We are going to introduce separate biological features and extract them one by one using suitable algorithms. The proposed method is used to extract the biological features of human iris. The proposed method uses crypts, pigment layers, and Wolfflin nodules features of iris. Each feature is extracted initially and suitable feature selection algorithm is identified. The manual cropping is initially applied in the eye image which extracts iris layer. The manual cropping is further applied on iris to locate the biological layers. Canny edge detection is applied on each iris feature. The FAST, SURF, MinEigen, BRISK, and MSER feature points are collected from each biological layer. The MinEigen extracts 218 feature points from the crypt layer. The BRISK extracts 161 and 89 feature points from the pigment and Wolfflin nodules. The proposed system can be used in iris recognition system all over the world for various authentication and security purposes. The individual feature extraction helps to make the recognition system more secure and accurate as compared to the existing systems which uses combined biological features. Thus, the proposed system is advantageous as compared to the existing systems and the efficiency will also be high if it is used for iris recognition.***

Keywords: ***Iris, crypts, furrows, Wolfflin nodules, pigment spots***

I. INTRODUCTION

An involvement of biometric in the human authorization places an important role. The direct and indirect human authentication is involved in the present scenarios. The direct human authorization is wider in the area of physical presence verification. Example it may use to monitor the employee's entry and exit system. The indirect method also called live wire verification.

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The human authentication is verified at the time of logging through internet or cloud connectivity. There are many biometrics available nowadays. Especially, a human eye consists of iris, sclera, and retina as biometric feature. Many features based in iris are available.

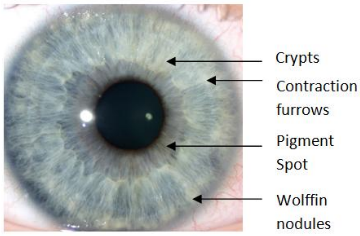


Fig.1 Structure of iris

The iris inner most layer is filled up with pupil. The structure of iris is shown in the Fig.1. The nature of pupil is compression and elongation. The compression and elongation is based on the light fall on the iris. Another feature of iris is pigment spot. The pigment layer is located next to the pupil area. The pigments normally appear deep in color.

The next feature is crypt. The crypt layer is located next to the pigment layer. The end near to the pigment layer appears like a wave shape as shown in the Fig.1. The end of the crypt layer is identified using contraction furrows. The contraction furrows are thin layer appeared in circular shape. The layer of Wolfflin nodule is located next to the contraction furrows. The contraction furrows is used to separate the crypt layer and Wolfflin nodules.

The visibility of the iris shows that the major layers are pigment spots, crypts, contraction furrows, and Wolfflin nodules.

II. REVIEW ON IRIS BIOMETRICS

A study on iris biometric from the up to the year of 2010 was carried out by Farmanullah (2017) [1]. The various obstacles of iris image processing such as eye lashes, eye lids, flash light impression, wave length, and image acquiring distance are discussed. The log gabor filter feature extraction and Naïve-Bayes Nearest-Neighbor (NBNN) based adaptive network was used for iris recognition by Nall (2017) [2]. Hofbauer et al (2018) [3] have proposed higher degree of accuracy-based iris recognition. The segmentation is based on using Convolution Neural Network (CNN).

The circular iris is converted into rectangular (rubber sheet form). The author concentrated in the segmentation. The segmentation is based on the mask.
Barpanda et al (2018) [4] have proposed wavelet coefficient features of iris. A bi-orthogonal Cohen-Daubechies-Feauveau filter bank with the tapping of 9/7 is used in this method. The feature is extracted in the form of energy level using DCT.

Gagan et al (2015) [5] have proposed the extraction of Discrete Cosine Transform (DCT) based iris feature extraction.

The proposal uses the image enhancement techniques such as histogram equalization, sharpening of image before extracting DCT features.

A Gray Level Coherence Matrix (GLCM) based feature extraction of iris was proposed by devi (2016) [6]. The segmented iris is normalized. The GLCM texture features are extracted from the normalized image.

Dharanesh et al (2017) [7] have proposed methodology for extraction and classification of iris features. The iris and pupil boundary was detected using canny edge detection and Hough transform procedure. The major features used in the algorithm are gabor, Discrete Wavelet Transforms (DWT), Fast Fourier Transform (FFT).

The wavelet based feature extraction was proposed by fathy (2017) [8]. The wavelet features, feature selection, Euclidian distance between the feature points are collected. The various statistical features such as variance, standard deviation, mean are used in this method.

Gale et al (2016) [9] have proposed the multi feature algorithm for iris recognition. The features include Haar transform, Principle Component Analysis (PCA), Block sum algorithm, and hybrid algorithm. The ANN based classifier is used in this method.

The elimination of iris hazards such as eye lashes and eye lids are performed by Thiyaneswaran (2012) [10]. The preprocessing steps such as median filtering, binarization, flash noise removal, morphological operations are used in this method. The radius and area of the iris is the key feature of proposed algorithm.

The extraction of moles from the portion of iris was proposed by Thiyaneswaran (2016) [11]. The author identifies iris area and ignores iris portion from the eye. Finally, the mole present in eye sclera is extracted. The iris area and diameter is the key feature for this algorithm.

The existing method extracts the combined feature of iris. The few algorithms take the area, diameter, and radius of the iris. The wavelet features are combined features from the pigment spots, crypts, Wolfflin nodules, and contraction furrows of iris structure. The proposed algorithm is motivated towards the extraction of pigment spots, crypts, Wolfflin nodules, and contraction furrows features from the iris structure.

III. PROPOSED METHOD

The block diagram of proposed algorithm is shown in the Fig.2. The detailed description of the proposed method is given below step by step.

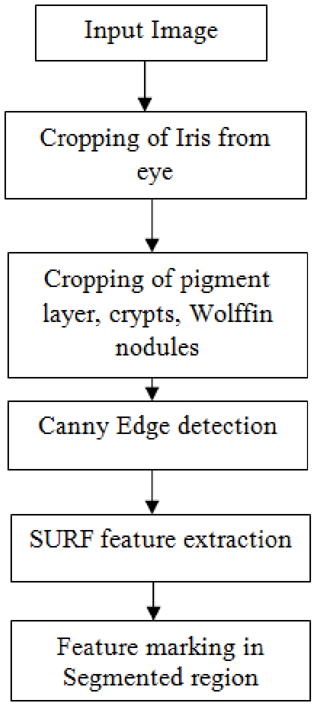


Fig.2. Block diagram of proposed methodology

Input Image: The first process is to acquire the image of an eye. The proposed method acquires the image from the camera or offline image.
Cropping of iris from the image: The manual cropping is applied on the eye image. Then the iris boundary is marked and cropped from the eye image. The concentration of the proposed algorithm is iris structure analysis. Therefore, the manual cropping is used in the proposed algorithm instead of automated.
Cropping of layers: The cropped iris visually shows the structural layers of iris. The cropping is applied on the specific layers and the specific part of the layer is manually cropped. The cropped layers are crypts, wolfflin nodules and pigment spots.
Edge Detection: The structural layers of iris have the distribution of blood vessels. The blood vessels are identified using edge detection techniques. In the proposed algorithm, canny edge detection is applied on the cropped pigment layer, crypts, and Wolfflin nodules. The various analysis are performed in each structural layer of iris.
SURF Feature Extraction: The Speeded-Up Robust Features (SURF) points are located in the edge detected image. The direct projection of SURF features on the cropped image will lead to detect a smaller number of feature points.
Feature Marking in segmented region: The SURF feature points are identified in the edge detected image.
The identified points are marked in original cropped layer for the analysis.

The paper focuses on the extraction of the crypts, furrows and various other features of the iris. The iris image is acquired from the database and the image is segmented. The segmentation gives the pure iris image. The pure iris image is then again segmented and the required features are extracted using various transforms.

IV. RESULT AND DISCUSSION

The input image is either captured using camera or offline images. The offline images are from the standard data base such as UBIRIS, CASIA, etc. The input is loaded into the proposed algorithm. The one of sample input image is shown in the Fig.3. The image is in the resolution of 1603 x 1600. The image is a colored one and each pixel represented using 3 colors.

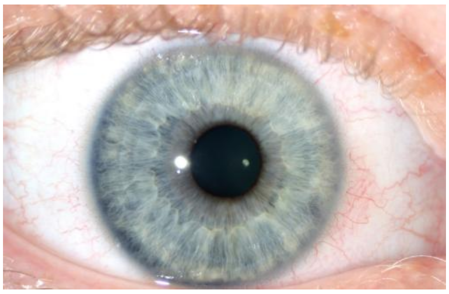


Fig. 3 Input image

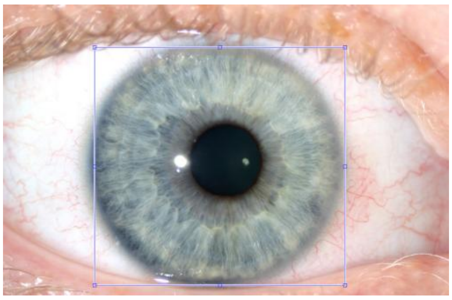


Fig.4 Manual Cropping of iris from eye

The manual cropping mask over the eye image is shown in the Fig.4. The mask is appeared in the blue color.

Fig.5 Cropped iris

The cropped result of iris is shown in Fig.5. The iris layers are clearly appeared. The required layer may be easily cropped as compared with the Fig.3.

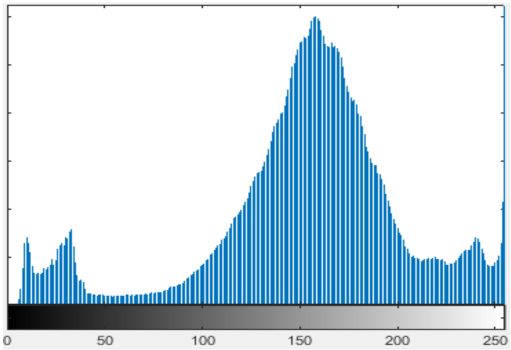


Fig. 6 Histogram analysis on iris structure

The histogram view of iris portion is alone shown in the Fig.6. The number pixel is distributed between 8 to 50 levels and 200 to 256.The maximum number of pixel is distributed in the level from 120 to 180.

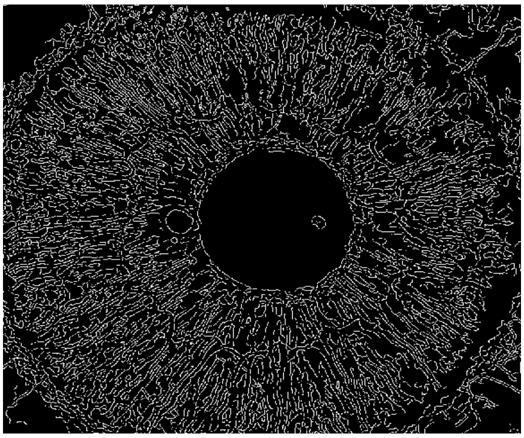
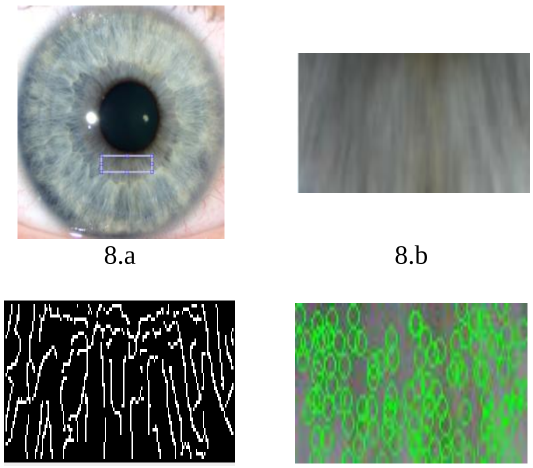


Fig.7 Edge detected view of cropped iris

The edge detection of iris image is shown in the Fig.7. The edges of blood vessel distribution are having more gaps as compared with the crypt layer. The crypt layer blood vessels are distributed very close with each other. The Wolfflin nodule blood vein distribution lies in between the pigment and Wolfflin nodule.



8.a 8.b

8.c 8.d

Fig.8. Pigment feature Extraction

The cropping mask in pigment layer is shown in the Fig.8a. The circular feature is converted into rubber sheet model and shown in the Fig. 8.b. The canny edges are detected in the rubber sheeted pigment and shown in the Fig. 8c. The BRISK feature points are located in the canny image and the brisk points are marked in rubber sheet pigment feature and it is shown in the Fig.8d. The number of identified BRISK points are around 161. It is of higher value as compared with the other features.

Table.1 Pigment layer feature analysis

S.N.	Feature	No. of Feature points
1	SURF	19
2	FAST	53
3	BRISK	161
4	Harris	74
5	MinEigen	104
6	MSER	3

The Table-1 shows the extraction feature point from the pigment layer. It shows that BRISK and MinEigen features are having more feature points from the pigment layer. The MSER is having only 3 feature points. The number of identified SURF points from the pigment layer is 19. The number of FAST and Harris feature are near with each other.

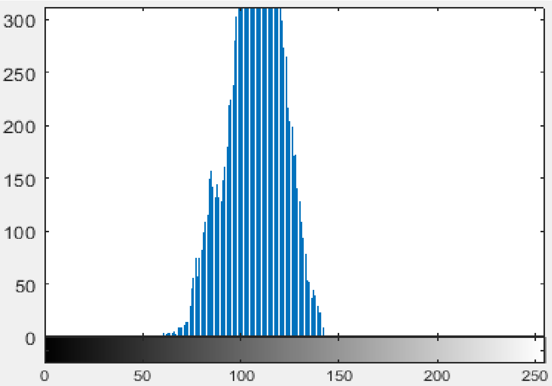
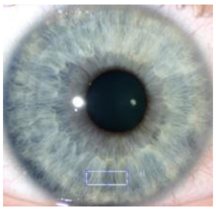
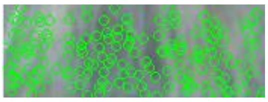


Fig.9 Histogram of pigment spot

The histogram of pigment feature is shown in the Fig.9. The colour distribution of pigment features lies in between 70 to 140 levels. The higher level of pixel occurrence is happened in the levels from 90 to 120 ranges.




10.a 10.b

10.c 10.d

Fig.10. Crypt feature Extraction

The cropping mask is placed in crypt layer which is shown in the Fig. 10.a. The extracted rubber sheet feature is shown in the Fig.10b. The canny edge detection is applied on the extracted rubber sheet crypt layer and the corresponding output is shown in the Fig.10c. The feature point is extracted from the edge image. It is marked in the crypt rubber sheet and shown in the Fig. 10d.

Table.2 crypt layer feature analysis

S.N.	Feature	No. of Feature points
1	SURF	35
2	FAST	98
3	BRISK	202
4	Harris	158
5	MinEigen	218
6	MSER	17

The various feature points of crypt layer is shown in the Table.2. The BRISK, MinEigen, Harris feature points scores more values as compared with SURF, FAST, and MSER.

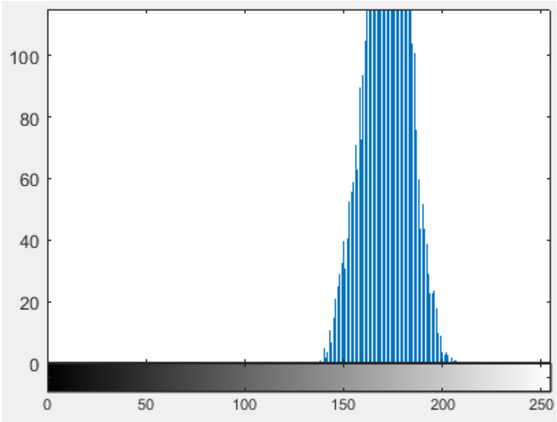
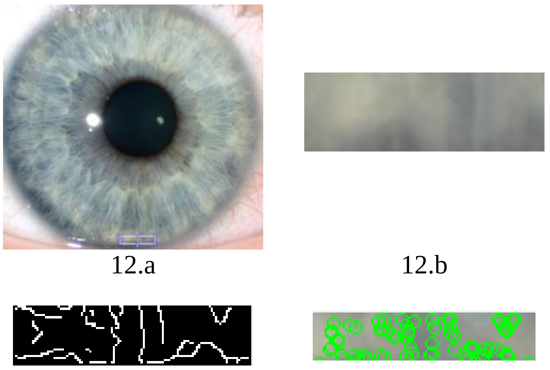


Fig.11. Histogram of crypt

The Histogram plot of crypt rubber model is shown in the Fig.11. The distribution of pixel lies between 140 to 200 levels. 140 levels is known as the end colour value of pigment spot. The maximum distribution is occurred from 150 to 180 levels.

The Wolfflin nodules mask is shown in the Fig.12.a. The rubber sheet Wolfflin feature is shown in the Fig.12b. The canny edge output is shown in the Fig. 12c. The BRISK identified feature points are shown in the Fig. 11.d on rubber sheet extracted image.

The Table-3 shows number of identified feature points in each algorithm. The number of SURF features is limited with the value 2. The BRISK score the 89 as a highest feature point in the Wolfflin nodules.



12.a 12.b

12.c 12.d

Fig.12. Wolfflin nodule feature extraction

Table.3 Wolfflin nodules feature analysis

S.N.	Feature	No. of feature points
1	SURF	2
2	FAST	13
3	BRISK	89
4	Harris	39
5	MinEigen	43
6	MSER	3

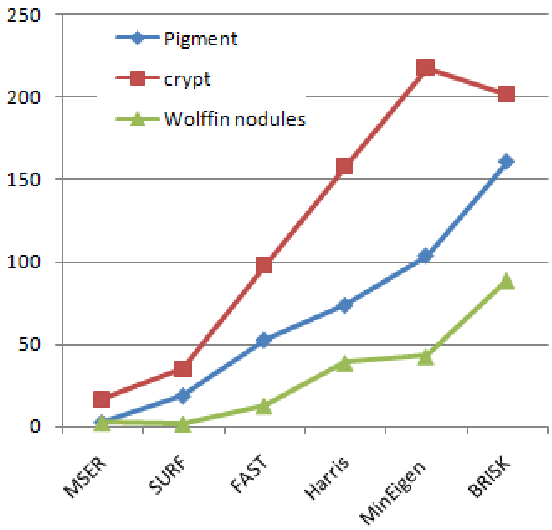


Fig.13. Comparative feature analysis

The pigment spot, crypt and Wolfflin nodule feature points are extracted using various algorithms. The corresponding analysis with the number of feature points collected is shown in the Fig.13. The analysis shows, BRISK feature extraction is suitable for IRIS pigment spot and Wolfflin nodules. The Harris method is suitable for crypt iris features.

V. CONCLUSION

The proposed method specifies the biological feature extraction of iris. The existing method uses the combined biological feature or its effect. In this paper each feature of iris is extracted separately. The iris feature extracted are pigment spots, crypts, and Wolfflin. After the extraction of these features the BRISK, SURF, MSER, MinEigen, Harris, and FAST features are extracted individually from each layer. The SURF and MSER points lie between 3 to 20. The BRISK is suitable for pigment and Wolfflin nodules iris layers which score the values in the range of 171, and 201. The proposed method helps the researcher to identify the suitable method for extracting biological features. The extracted biological features can be used for iris recognition process because of its high accuracy and precision.

REFERENCES

1. Farmanullah Jan, Segmentation and localization schemes for non-ideal iris biometric systems, Elsevier, Signal Processing 133 (2017) 192–212.
2. Pattabhi Ramaiah Nalla and Ajay Kumar, Toward More Accurate Iris Recognition Using Cross-Spectral Matching, IEEE transactions on image processing, Vol. 26, No. 1, January 2017.
3. Heinz Hofbauer, Ehsaneddin Jalilian, Andreas Uhl, Exploiting superior CNN-based iris segmentation for better recognition accuracy, Elsevier, Multimedia Signal Processing and Security, Pattern Recognition Letters 120 17–23 (2019)
4. Soubhagya Sankar Barpanda, BanshidharMajhi, Panjak Kumar S, Arun Kumar Sangaiah, SambitBakshi, Iris feature extraction through wavelet mel-frequency cepstrum coefficients, Elsevier, Optics and Laser Technology, 2018.
5. Gagan R, Lalitha. S, Elliptical Sector Based DCT Feature Extraction for IRIS Recognition, IEEE Xplore, 2015
6. Krishna Devi, Diksha Grover, An Effective Texture Feature Extraction Approach For Iris Recognition System, IEEE xplore, 2016.
7. Dharanesh C M, Ragvendra Prasad, Chandrashekar M Patil, Feature Extraction & Classification for Personal Identification using Iris, International Conference on Current Trends in Computer, Electrical, Electronics and Communication (ICCTCEEC-2017), IEEE Xplore, PP: 431-435, 2017.
8. Waleed S-A. Fathy, Hanaa S. Ali2, Imbaby I. Mahmoud, Statistical Representation for Iris Anti-Spoofing Using Wavelet-Based Feature Extraction and Selection Algorithms, IEEE Xplore, 2017, pp. 221-229.
9. Aparna G. Gal, Suresh S. Salankar, Evolution of Performance Analysis of Iris Recognition System By using Hybrid Methods of feature Extraction and Matching by Hybrid Classifier for Iris Recognition System, International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), IEEE Xplore, pp. 3259-3263, 2016.
10. Sandhiya D, Thiyaneswaran B, Extraction of dorsal palm basilic and cephalic hand vein features for human authentication system, IEEE International Conference on wireless communication signal processing and networking (WISPNET'17), pp: 2260-2264, 2017.
11. Thiyaneswaran B, Kandiban R, Jayakumar K S, Elimination of iris hazards indented for localization using visible features for IRIS region, Procedia Engineering, Vol.38, pp: 246-252, 2012.
12. Thiyaneswaran B, Saravanakumar A, Kandiban R: Extraction of Mole from Eye Sclera using Object Area Detection Algorithm, IEEE International Conference on wireless communication signal processing and networking, pp: 1413-1417 (2016).
13. B. Thiyaneswaran, K. Anguraj, R. Kandiban, N. S. Yoganathan, J. Jayanthi, An Imaging Based Lung Tissue and Spread Level Detection for Early Detection of Cancer, International Journal of Recent Technology and Engineering (IJRTE), Volume-8 Issue-2, July 2019

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