Periocular Biometric Recogniton Using Neural Network

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***Abstract*—Periocular localization is a topic that is rich, to the area around the eyes, which can include such highlights as the eternal one, the eyelashes and eyebrows, removing the pipes, the eye of the shape of the skin to the surface, and a few others. A confirmation of the scheme, which is based on the periocular region is a worthy compromise between the need for biometric validation system based on face and iris, as they require a high level of customer collaboration. With shockingly high segregation capacity, this district can be effectively gotten with existing arrangements for face and iris, and the prerequisite of client participation can be loose, subsequently working with the association with biometric frameworks. It is likewise accessible over a wide scope of distances in any event, when the iris surface can't be dependably taken (low goal) or under incomplete face impediment (close distances). Here, we survey the cutting edge in periocular biometrics research. This paper gives an exhaustive overview of periocular biometrics and proposed NN based calculation for highlight extraction and characterization which have better collectability, adequacy, and circumvention.**

Keywords: Periocular Biometric, Biometric Authentication, Feature Extraction, Face Biometric, CNN

I. Introduction

Periocular acknowledgment is valuable in applications where it is hard to execute the iris and the face biometrics. Securing of the Periocular biometrics has required an enormous number of client collaboration. An early investigation of the periocular acknowledgment exhibited promising outcomes in controlled conditions. It isn't unexpected to depict the periocular area as the district in the quick area of the eye. Among the best of the available biometric data, for example, a person's unique fingerprint, and iris, the iris is better to be considered, as it draws the attention of a critical distance, regardless of whether it is a natural part of the eye. The Iris control is to control the man is currently being carried out around the world, in varying degrees, and is currently being studied in order to make it safer and more powerful. Several of the covariates affect the overall image of the iris recognition. One such covariate is the periocular biometric which alludes to the facial region in the quick area of the eyeball. In non-ideal conditions, where iris acknowledgment falls flat, the periocular area comes as a rescuer. Periocular area can likewise go about as a delicate biometrics and adds to the exactness and execution of the iris acknowledgment framework. Biometrics is an innovation to distinguish individuals dependent on their physical and social attributes. Improvement in the field of biometrics has prompted advancement of a quality that is non-meddling, generally adequate and can be caught distantly with compelling highlights. Steps of biometric acknowledgment are appeared in fig 1.

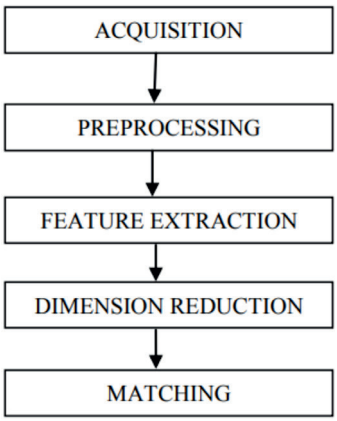

Fig. 1: Biometric Recognition Steps

Lately, periocular acknowledgment is acquiring consideration from the biometrics local area because of its promising acknowledgment execution. Periocular for the most part alludes to the locale around the eyes, ideally including the eyebrow. Periocular qualities are portrayed in fig 1. Periocular Biometric frameworks are applied for the one of a kind recognizable proof of a person by assessing at least one distinctive organic qualities. Validation assumes a significant part as the principal line of guard against gatecrashers. The quantity of frameworks that have been undermined is consistently expanding and biometric check is any methods by which an individual can be extraordinarily recognized by assessing at least

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one distinctive natural qualities. Periocular biometric acknowledgment depends on the presence of the locale around the eye.

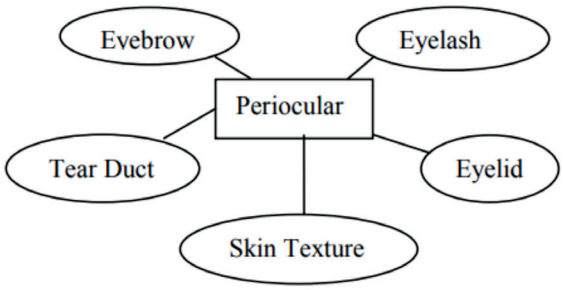

Fig. 2: Periocular Traits [4]

The presentation of iris acknowledgment is influenced if iris is caught a good ways off, likewise influenced for subjects who are visually impaired or have waterfalls and the exhibition of face acknowledgment is influenced by lighting changes, hair of the individual, the age and if the individual wears glasses [10].

II. Literature Survey

The presentation of iris acknowledgment is influenced if iris is caught a way off, additionally influenced for subjects who are visually impaired or have waterfalls and the exhibition of face acknowledgment is influenced by lighting changes, hair of the individual, the age and if the individual wears glasses [10]. Periocular refers to the region of the face, near the eyes, including the eyes, eye lashes and eyebrows. At the same time, as a human iris is a well-studied, the periocular district has arisen as a promising characteristic for unconstrained biometrics, following requests for expanded heartiness of face or iris frameworks. With a shockingly high separation capacity, this area can be effortlessly gotten with existing arrangements for face and iris, and the prerequisite of client participation can be loose, consequently working with the cooperation with biometric frameworks. It is additionally accessible over a wide scope of distances in any event, when the iris surface can't be dependably gotten (low goal) or under fractional face impediment (close distances).

In particular, the face and the iris of the eye prior to the approval of the individuals with the most advanced biometric characteristics, Still thought of non-ideal pictures, (for instance, pictures with assortment in present, slanting head, subjects wearing presentations and assortment in getting contraption partition) can corrupt the affirmation exactness of any biometric systems. For the present circumstance, periocular region (nearby district around the eye) based biometric affirmation is a rising technique which is used by experts now a days to improve the affirmation precision expressly for non-ideal pictures and when customers are non-pleasing. In this particular condition, maker's key information is to develop a structure considering periocular locale as a biometric quality and intend to survey its sufficiency for request of non-ideal pictures in two different non-ideal circumstances pictures with different stance assortment and pictures got from varying camera impasse division. In [1], Punam Kumari and Seeja K. R. evaluated three unmistakable painstakingly collected feature descriptors 1) Histogram of Oriented Gradients 2) Bag of Feature model and 3) Local Binary Patterns on two remarkable data bases 1) ORL face data base and 2) UBIPr periocular picture data base and found that HOG incorporate descriptor show preferred execution as take a gander at over BOF and LBP feature descriptor for periocular region based biometric affirmation structures.

Alonso-Fernandeza, Josef Bigun [2] investigated the top tier in periocular biometrics research. Different viewpoints are depicted, including: I) existing data bases, ii) estimations for periocular revelation or possibly division, iii) features used for affirmation, iv) recognizing confirmation of the most discriminative spaces of the periocular region, v) assessment with iris and face modalities, vi) sensitive biometrics (sex/personality portrayal), and vii) impact of sex change and plastic operation on the affirmation precision. This work is needed to give a comprehension of the main issues in periocular biometrics, giving an exhaustive incorporation of the current composition and present status of the craftsmanship.

The work "A Comprehensive Study of Periocular Biometrics on IRIS Recognition", [3] first gives a course of occasions framework of the headway of the biometrics for contextualization followed by a precise and broad review of periocular biometrics on iris affirmation.

Biometrics is an advancement to perceive people subject to their physical and lead characteristics. Redesign in the field of biometrics has incited improvement of a quality that is non-intrusive, extensively agreeable and can be gotten indirectly with amazing features. Face biometric is for the most part used quality all over world. On account of less usefulness of face biometric in non-supportive environment, researchers propose to use a sub space of face that is all the more impressive. Periocular biometric is area incorporating the eyes having modalities including eyebrows, eyelashes, and eyelids, tear channel and skin surface. Paper [4] explored usage of periocular locale and its modalities in face affirmation including periocular data bases and its use in future for various applications.

The fundamental objective of [5] was to give an illustrative point of view on periocular biometrics composing and about what features, incorporate extraction systems and planning plans are presently the

assessed and remaining issues that may be overlooked in the sector. With the rapidly creating imaginative world, it is important that the system used to monitor human verification and testing should require minimal customer cooperation and periocular biometrics is a by and large phenomenal response for this issue. Periocular region can be regarded as promising quality as a single way and as a facial support with biometric iris. Periocular locale achieved better result generally speaking where face biometric encounters different prerequisites like stance, lighting up assortment, hindrance and developing effect. Blend of iris and periocular region also cultivated better results when stood out from iris as an autonomous philosophy.

Leslie Ching Ow Tiong et al [6] notwithstanding the types of progress made in the periocular affirmation, the dataset and periocular affirmation in the wild stays a test. In this paper, we propose a multi-facet mix approach by techniques a few common limits (twofold stream) convolutional neural association where every association recognizes RGB data and a novel concealing based surface descriptor, explicitly Orthogonal Combination-Local Binary Coded Pattern (OC-LBCP) for periocular affirmation in nature. Specifically, two obvious late-blend layers are introduced in the twofold stream association to add up to the RGB data and OC-LBCP.

A story approach for picking a rectangular organization around periocular area in a perfect world potential for human affirmation is proposed in [7]. An almost greater configuration of periocular picture than the ideal one can be to some degree all the more remarkable for affirmation, however the larger format enthusiastically slows down the biometric system by making the computer-based output a factor and increasing the data base size. A more unobtrusive configuration, really, can't yield appealing affirmation anyway the more unassuming design performs faster in view of low estimation for feature extraction. These two clashing objectives (to be explicit, (a) to restrict the size of periocular design and (b) to increase the affirmation through the organization) are expected to be smoothed out through the proposed research. This paper proposes four one of a kind procedures for dynamic ideal format assurance from periocular region.

In [8], Park, U., Jillela, et al analyzed the usage of the periocular region for biometric affirmation and surveyed its organizing show using three unmistakable matchers subject to worldwide and neighborhood incorporate extractors, viz., GO, LBP, and SIFT. The effects of various variables, for instance, division, visible presentation, and eyebrows on periocular biometric affirmation execution were analyzed. An assessment between face affirmation and periocular affirmation execution under replicated nonideal conditions (hindrance) was furthermore presented. Also, the effects of stance assortment, obstruction, remedial changes, and format developing on periocular affirmation were presented. Examinations show that it is attractive over join eyebrows and use unprejudiced visible presentation for exact periocular affirmation.

The display of iris affirmation is impacted if iris is gotten far off. Further, pictures trapped in recognizable reach are more defenseless to upheaval than if trapped in near infrared reach. Assessment "Periocular biometrics: When iris affirmation misses the mark." [9] Proposed periocular biometrics as a choice as opposed to iris affirmation whether the iris pictures are gotten far off. We propose a novel estimation to see periocular pictures in perceptible reach and study the effect of catch division on the show of periocular biometrics. The introduction of the estimation is surveyed on more than 11,000 photos of the UBIRIS v2 data base. Results show confirmation of use of periocular region authentication where details are insufficient for iris verification.

Periocular affirmation has been a working assessment district in the field of biometrics. The periocular locale is ordinarily a rectangular region limited by the eye place or the internal and outside corners of the eye. Selecting features that address the strong and discriminatory structures of the periocular region is perhaps the most essential tasks in the periocular affirmation issue. Paper [10] took care of this component extraction issue and proposes a novel method to manage viably remove discriminative properties of the periocular region with high affirmation execution. The capacity to take in generous features from the photos makes Bayesian assistance vector machine (BSVM) engaging for affirmation. Harlick features and edge histogram descriptor is used to isolate the features of getting ready pictures.

Fernando Alonso-Fernandez [11] Periocular affirmation has ascended as a promising quality for unconstrained biometrics after demands for extended strength of face or iris systems, showing an amazingly high detachment limit. The fastgrowing take-up of face progressions in casual networks and PDAs, similarly as the extensive usage of perception cameras, apparently fabricates the energy of periocular biometrics. The periocular region has exhibited to be more receptive toward capriciousness in disposition, obstruction, and it has more noteworthy limit of planning fragmented faces.

Akanksha Joshi [12], actually periocular biometrics has drawn a lot of thought of investigators and a couple of attempts have been presented in the composition. In this paper, we propose a novel with a strong periocular validation strategy. In the philosophy, the face is recognized in still face pictures which are then changed and normalized. We utilized the entire strip containing both the eyes as a periocular region.

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Unsang Park [13], the word periocular suggests the location of the face in the immediate area of the eye. Getting of the periocular biometrics is depended upon to require less subject joint effort while permitting a greater significance of field diverged from standard visual biometric qualities (viz., iris, retina, and sclera). In this work, we study the feasibility of using the periocular circuit as a biometric standard. Worldwide and neighborhood information are isolated from the periocular area using surface and point executives achieving a rundown of capacities for addressing and organizing this region.

Nirgish Kumar [14] Periocular insinuates the facial area in the district of the eye, including eyelids, lashes and eyebrows. While face and irises have been comprehensively thought about, the periocular region has ascended as a promising quality for unconstrained biometrics, following solicitations for extended force of face or iris systems. With incredibly high division limit, this district can be conveniently gotten with existing plans for face and iris, and the need of customer coordinated effort can be free, thusly promising the association with biometric structures. It is furthermore available over a wide extent of partitions regardless, when the iris surface can't be reliably gotten (low objective) or under inadequate face obstruction (close divisions). Here, we review the front line in periocular biometrics research.

Felix Juefei-Xu; MariosSavvides [15] The display of the periocular locale is differentiated and that of full face with different lighting up preprocessing plans. The check results on the periocular area show that subspace depiction on DT-LBP beats LBP basically and builds a goliath hop from ordinary subspace depiction on unrefined pixel power. In addition, our proposed approach using simply the periocular locale is almost commensurate to a full face with simply 2.5% decline within proper limits rate at 0.1% false recognize rate, yet we acquire flexibility to attitude, obstacle, and limit of organizing deficient faces in swarms.

Table 1 shows Periocular regionand periocular modilities in face recognition

Table 1: Periocular Modalities

Year	Author	Feature	Feature Extraction Algorithm	Classifier	Database	Accuracy (%)
2020	Punam Kumari, Seeja K. R [1]	Periocular	LBP	SVM	ORL UBIPr	89 %
			HOG			90%
			BOF			85%
2013	Ujair et al [16]	Periocular	LBP	PCA	UBIPr	99%
2011	Park et al [8]	Periocular	GO/LBP/SIFT	Euclidian	FRG	87.32%
2014	Sharma et al [17]	Periocular	PHOG	NN	IMP	48%
2008	Savvides et al [18]	Tear duct, iris	Haar wavelets	SVM/PCA/LDA	ICE	90%
2020	Harsha. Net al [10]	Periocular	BSVM	ANN	CSIP	92.8%
2012	Ross et al. [19]	Periocula r + Face	SIFT, LBP,	VerilookPittpatt	Plastic surgery Images	Perio-63. 9% Face-85. 3% Fusion87. 4%
2011	Patel et al. [20]	Pupil	Haar wavelets	Hamming distance	CASIA V1	94.86%
2010	Miller et al. [21]	Skin texture (both eye)	LBP	City block distance	FRGC	89.76%

III. Proposed System

Periocular image from database is taken as input image. The purpose of pre-processing is the development of image data that suppresses unwanted distortions (i.e. noise removing) and enhances some image features important for further processingSometimes it is interesting to process one image area, leaving the other regions unchanged. It is generally referred to as region-of-interest (ROI) processing. Block diagram of proposed system is shown in figure 3.

A locale of interest (ROI) is a segment of a picture that you need to channel or play out some other procedure on. return for money invested is extricated from input picture in pre-preparing step. Highlights like surface, shading, factual highlights are removed in include extraction step. Further CNN calculation is applied on extricated highlight to order periocular picture and perceives input picture.

CNN is a naturally enlivened variations of multi-facet perceptron (MLP) and notable as one of common profound learning structures. CNN has shown solid capacity to take in successful element portrayal from

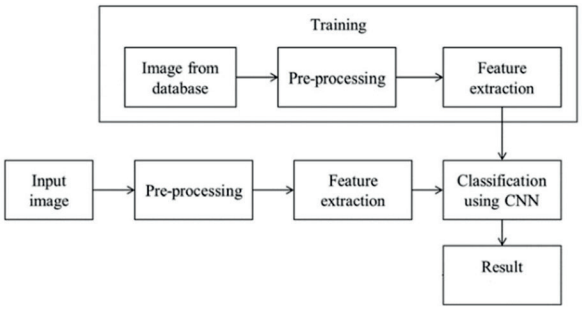

Fig. 3: Block Diagram of Proposed System

input information particularly for picture/video getting errands, for example,

transcribed character acknowledgment, enormous scope picture grouping, face acknowledgment and so tc. CNN is often made up of layers of convolution, integration layers and completely related layers (FC). At the yield of each layer, there is regularly a nonlinear initiate work, for example, sigmoid, ReLU, and so forth The information picture is gone through a few convolutional units and afterward a couple of completely associated layers. The yield of the keep going FC layer with N (number of classes) hubs would address probabilistic forecast to the class names. All parts of the convolution are made in three parts - a convolution layer, a maximum pooling layer and a ReLU (Rectified Linear Unit) actuation work, as demonstrated in Figure 4.

For the convolutional layer, each channel of its output is calculated as follows:

$$y^{(i)} = \sum_j \left(b^{(ij)} + k^{(ij)} * x^j \right) \quad (1)$$

Where $y^{(i)}$ is i-th channel of the output map, x^j is the j-th channel of the input map, $b^{(ij)}$ is called the bias term, $k^{(ij)}$ is the convolution kernel between $y^{(i)}$ and x^j, and * denotes the 2D convolution activity. $b^{(ij)}$ and $k^{(ij)}$ will be learned by back-spread therefore the convolution components are ready to remove the most prominent discriminatory points in various subjects. The pooling layer removes one greatest or normal worth from each fix of the information channel. In our application, we use max-pooling with non-covering patches. Therefore, the data maps,, after convolution, were examined under a scale controlled by the pooling part.

The pooling activity totals low-level highlights from the contribution to significant level portrayal and in this manner could accomplish spatial invariance among various examples. At the yield of each pooling layer and the principal FC layer (e.g., L7 in Figure 4), we pick the ReLU (Rectified Linear Unit) as the initiation work:

$$y_i' = \max(y_i, 0) \quad (2)$$

The ReLU activation ensures the nonlinearity of the feature extraction process and effective for training, compared to traditional activation functions like sigmoid or tanh employed in other ways. The FC layers process the input as in conventional neural networks:

$$y_i = b_i + \sum_j x_j w_{ij} \quad (3)$$

where x_j is the j-th element of the vectorized input map to the current layer, y_i is the i-th element of the output map, which is also a vector. bi and wij are elements of the bias and weights to be learned through training. The last FC layer, as usually configured in classification problem, is not followed by ReLU but a softmax function

$$y_j'' = \frac{e^{y_j}}{\sum_j e^{y_j}} \quad (4)$$

Use of softmax function for final output of network results in a 1×N vector with positive elements which are summed up in one. Each element then is treated as the probabilistic prediction of the class label. The cross-entropy loss function should be reduced, which is done as:

$$L(y'') = -\log y_t'') \quad (5)$$

where t is the ground truth label of the training sample.

The loss function is minimized via back-propagation so that the predictions of the g round truth class of the training samples is closer to unity.

IV. Result

$$\textit{Overall Classification Rate (OCR)} = \frac{\textit{total no. of correctly classified images}}{\textit{total number of images}} \times 100$$

Table 2: The Performance of Algorithm

Name of Classifier	Total Number of Correctly Classified Images	OCR
Back propagation Neural Network	10793	98.11818182

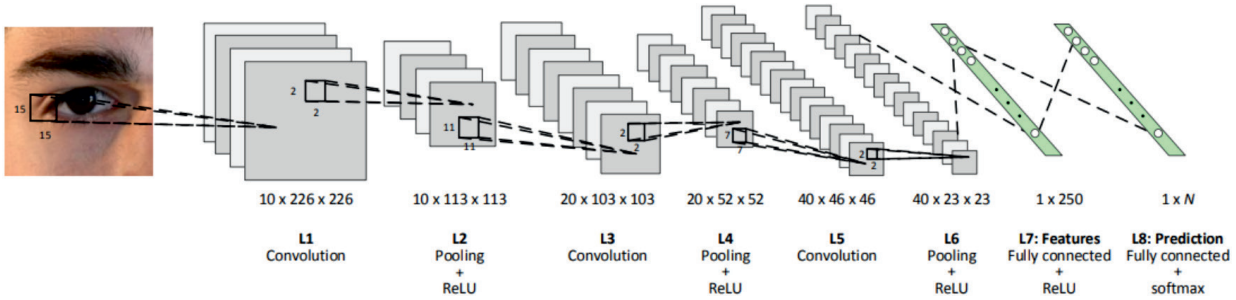

Fig. 4: Structure of Convolutional Neuron Network

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We have performed training of images and then testing is performed to get the classification rate. We have tested and here is the result. It has been clearly observed that the OCR of the Back Propagation Neural Network is acceptable. By observing the OCR,we can easily conclude that Back Propagation Neural Network is a good choice for periocular biometric system.

V. Conclusion

Periocular recognition has emerged as a promising practice for unconstrained biometrics following requirements for the rigidity of the facial or iris system indicating a surprisingly high discriminatory ability. It also finds performance in other areas such as forensics analysis. In such a case, identifying a suspect where the periocular region is seen is one of the world's most difficult biometric challenges . Even in this difficult situation, the periocular region can help in the reconstruction of the entire face. In this paper numerous literature are review and it is found that that the periocular region also has similar collectability, acceptability, and circumvention to the face biometric because it is found within the same image. From Survey it is proved thatperiocular area could be an ideal biometric parameter. We proposed a novel method for periocular biometric systemusingmachine learning CNN which is superior to other algorithm andalso have similar collectability, acceptability, and circumvention to the face biometric.

References

[01] Punam Kumari, Seeja K. R. "Periocular Biometrics using Handcrafted Features for Non-Ideal Images", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-8 Issue-5, January 2020

[02] Fernando Alonso-Fernandeza, Josef Bigun"A Survey on Periocular Biometrics Research" arXiv:1810.03360v1 [cs.CV] 8 Oct 2018

[03] Sunil Kumar Vijay Kumar Lamba3 , Surender Jangra,"A Comprehensive Study of Periocular Biometrics on IRIS Recognition",International Journal of Control and Automation Vol. 12, No.5, (2019), pp. 391 - 401 ISSN: 2005-4297 IJCA 391 Copyright © 2019 SERSC

[04] Arun Goel, Alka Jindal "Use of Periocular Biometric in Face Recognition", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-8, Issue-9S, July 2019

[05] P. Kumari and K. R. Seeja, Periocular biometrics: A survey, Journal of King Saud University –Computer and Information Sciences, https://doi.org/10.1016/j.jksuci.2019.06.003

[06] Leslie Ching Ow Tiong, "Periocular Recognition in the Wild with Orthogonal Combination of Local Binary Coded Pattern in Dual-stream Convolutional Neural Network", arXiv:1902.06383v1 [cs.CV] 18 Feb 2019

[07] SambitBakshi, Pankaj K. Sa, and Banshidhar Majhi, "Optimized Periocular Template Selection for Human Recognition",Hindawi Publishing Corporation BioMed Research International Volume 2013, Article ID 481431, 14 pages http://dx.doi.org/10.1155/2013/481431 Research Article

[08] Park, U., Jillela, R.R., Ross, A., & Jain, A. K. (2011). Periocular Biometrics in the Visible Spectrum. IEEE Transactions on Information Forensics and Security, 6(1), 96–106. doi:10.1109/tifs.2010.2096810

[09] Bharadwaj, S., Bhatt, H. S., Vatsa, M., & Singh, R. (2010). Periocular biometrics: When iris recognition fails. 2010 Fourth IEEE International Conference on Biometrics: Theory, Applications and Systems (BTAS). doi:10.1109/btas.2010.5634498

[10] Harsha. N, Dr. Balamurugan. A; "Enhancing periocular recognition using Bayesian support vector machine attractive for recognition", International Journal of Advance Research, Ideas and Innovations in TechnologyISSN: 2454-132X Impact factor: 4.295 (Volume6, Issue1) © 2020, www.IJARIIT.com

[11] Fernando Alonso-Fernandez and Josef Bigun, "A survey on periocular biometrics research", Pattern Recognition Letters Elsevier, October 18, 2015

[12] Akanksha Joshi, "Periocular Recognition Based On Gabor And ParzenPnn", ©2014 IEEE

[13] Unsang Park, "Periocular Biometrics in the Visible Spectrum", IEEE Transactions On Information Forensics And Security, Vol. 6, No. 1, March 2011

[14] Nirgish Kumar, "Periocular Biometrics for Iris Recognition: A Review", IJSR, Volume 6 Issue 7, July 2017.

[15] Felix Juefei-Xu; MariosSavvides, "Subspace-Based Discrete Transform Encoded Local Binary Patterns Representations for Robust Periocular Matching on NIST's Face Recognition Grand Challenge", vol 23, issue 8, IEEE. June 6.

[16] M. Uzair, A. Mahmood, A. Mian, and C. McDonald, "Periocular biometric recognition using image sets," in 2013 IEEE Workshop on Applications of Computer Vision (WACV), 2013, pp. 246–251

[17] A. Sharma, S. Verma, M. Vatsa, and R. Singh, "On cross spectral periocular recognition," in 2014 IEEE International Conference on Image Processing (ICIP), 2014, pp. 5007–5011.

[18] R. Abiantun and M. Savvides, "Tear-duct detector for identifying left versus right iris images," in 2008 37th IEEE Applied Imagery Pattern Recognition Workshop, 2008, pp. 1–4.

[19] R. Jillela and A. Ross, "Mitigating effects of plastic surgery: Fusing face and ocular biometrics," in 2012 IEEE Fifth International Conference on Biometrics: Theory, Applications and Systems (BTAS), 2012, pp. 402–411.

[20] H. Patel, C. K. Modi, M. C. Paunwala, and S. Patnaik, "Human Identification by Partial Iris Segmentation Using Pupil Circle Growing Based on Binary Integrated Edge Intensity Curve," in 2011 International Conference on Communication Systems and Network Technologies, 2011, pp. 333–338.

[21] P. E. Miller, A. W. Rawls, S. J. Pundlik, and D. L. Woodard, "Personal identification using periocular skin texture," in Proceedings of the 2010 ACM Symposium on Applied Computing - SAC '10, 2010, p. 1496