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Enhancing periocular recognition using Bayesian support vector machine attractive for recognition

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ABSTRACT

Periocular recognition has been an active research area in the field of biometrics. The periocular region is normally a rectangular region localized by the eye centre or the inner and outer corners of the eye. Choosing features that represent the reliable and discriminative properties of the periocular region is one of the most critical tasks in the periocular recognition problem. This project tackles this feature extraction problem and proposes a novel approach to efficiently extract discriminative properties of the periocular region with high recognition performance. The proficiency to learn robust features from the images makes Bayesian support vector machine (BSVM) attractive for recognition. Harlick features and edge histogram descriptor is used to extract the features of training images.

Keywords— *Biometrics, Periocular recognition, extraction, Bayesian support vector machine and Harlick features*

1. INTRODUCTION

In recent years, periocular recognition is gaining attention from the biometrics community due to its promising recognition performance. Periocular usually refers to the region around the eyes, preferably including the eyebrow. Periocular Biometric systems are applied for the unique identification of an individual by evaluating one or more distinguishing biological traits. Authentication plays a major role as the first line of defence against intruders. The number of systems that have been compromised is ever-increasing and biometric verification is any means by which a person can be uniquely identified by evaluating one or more distinguishing biological traits. Periocular biometric recognition is based on the appearance of the region around the eye. The performance of iris recognition is affected if iris is captured at a distance, also affected for subjects who are blind or have cataracts and the performance of face recognition is affected by lighting changes, hair of the person, the age and if the person wears glasses [1]. Periocular recognition is useful in applications where it is difficult to implement the iris and the face biometrics. Acquisition of the Periocular biometrics has required a large number of user cooperation. An early study of the periocular recognition was done by Park et al. [2], which demonstrated promising results in controlled environments. It is common to describe the periocular region as the region in the immediate vicinity of the eye. Convolutional Neural Networks (CNNs) have become a very popular tool in many vision tasks. Their application to biometrics is however limited, with recent works on face recognition and detection, iris recognition, soft biometrics, and image segmentation Convolutional Neural Network (CNN) has gained exponential attention to learn high-dimensional data in the computer vision domain. CNN with color-based texture descriptors have successfully been employed in numerous vision applications, such as emotional recognition and texture classification demonstrated that using the color texture do provide complementary information to improve CNN in extracting feature representations [3]. In their analysis, they showed that texture descriptors are ubiquitous enough to represent an object, especially when the shape cannot be visualized clearly. For periocular recognition in controlled environments, exploited two CNNs, which extract comprehensive periocular information from left and right oculars. The feature extraction based on regions-of-interest of periocular with CNNs. Both networks exploit prior knowledge by discarding unnecessary information to enhance CNN in periocular recognition [4]. However, these networks are not well-performed in the wild environment, such as when the periocular images are misaligned or the periocular images do not include the eyebrows or ocular perfectly. To this effect, mask the eye in the periocular region thus removing the iris and various level-one features. Although removal of the eye from a periocular region image may seem like a heavy loss of discriminating information, it could be potentially advantageous as the level-one features are highly sensitive to the opening and closing of the eyes and may end up influencing the texture features adversely [5]. The deep CNN model is trained via the proposed heterogeneous aware loss metric based on the identity of the subjects and tries to enforce a margin between the clusters of images of a particular identity/class in the embedding space. The embedding of the same subject/classes are brought close to each other and that of other subjects are pushed away from each other in the output embedding space of the deep CNN model. In addition to that, the loss function ensures that the model produces heterogeneity aware embedding [6]. A large number of techniques have performed periocular recognition on data obtained with high-quality sensors in constrained conditions but there has been increasing focus on the less constrained scenarios as well. Many popular methods relied on handcrafted features like HOG, SIFT and LBP for the periocular and iris information [7, 8]. The proposed periocular recognition process consists of a sequence of operations: image alignment (for the global matcher described below), feature extraction, and matching. We adopt two different approaches to the problem: one based on global information and the other based on local information. The two approaches use different methods for feature extraction and matching.

2. LITERATURE REVIEW

Leslie Ching Ow Tiong et al [9] In spite of the advancements made in the periocular recognition, the dataset and periocular recognition in the wild remains a challenge. In this paper, we propose a multilayer fusion approach by means of a pair of shared parameters (dual-stream) convolutional neural network where each network accepts RGB data and a novel color-based texture descriptor, namely Orthogonal Combination-Local Binary Coded Pattern (OC-LBCP) for periocular recognition in the wild. Specifically, two distinct late-fusion layers are introduced in the dual-stream network to aggregate the RGB data and OC-LBCP. Thus, the network beneficial from this new feature of the late-fusion layers for accuracy performance gain. We also introduce and share a new dataset for periocular in the wild, namely Ethnic-ocular dataset for benchmarking. The proposed network has also been assessed on two publicly available datasets, namely CASIA iris distance and UBIPr. The proposed network outperforms several competing approaches on these datasets.

Fernando Alonso-Fernandez [10] Periocular recognition has emerged as a promising trait for unconstrained biometrics after demands for increased robustness of face or iris systems, showing a surprisingly high discrimination ability. The fast-growing uptake of face technologies in social networks and smartphones, as well as the widespread use of surveillance cameras, arguably increases the interest of periocular biometrics. The periocular region has shown to be more tolerant of variability in expression, occlusion, and it has more capability of matching partial faces. It also finds applicability in other areas such as forensics analysis (crime scene images where perpetrators intentionally mask part of their faces). In such a situation, identifying a suspect where only the periocular region is visible is one of the toughest real-world challenges in biometrics. Even in this difficult case, the periocular region can aid in the reconstruction of the whole face. This paper reviews the state of the art in periocular biometrics research. Our target is to provide comprehensive coverage of the existing literature, giving an insight into the most relevant issues and challenges. We start by presenting existing databases utilized in periocular research. Acquisition setups comprise digital cameras, webcams, video, cameras, smartphones, or close-up iris sensors. A small number of databases contain video data of subjects walking through an acquisition portal, or in hallways or atria.

Akanksha Joshi [11], recently periocular biometrics has drawn a lot of attention of researchers and some efforts have been presented in the literature. In this paper, we propose a novel and robust approach for periocular recognition. In the approach, the face is detected in still face images which are then aligned and normalized. We utilized the entire strip containing both the eyes as a periocular region. For feature extraction, we computed the magnitude responses of the image filtered with a filter bank of complex Gabor filters. Feature dimensions are reduced by applying Direct Linear Discriminant Analysis (DLDA). The reduced feature vector is classified using Parzen Probabilistic Neural Network (PPNN). The experimental results demonstrate a promising verification and identification accuracy, also the robustness of the proposed approach is ascertained by providing a comprehensive comparison with some of the well-known state-of-the-art methods using publicly available face databases.

Unsang Park [12], the term periocular refers to the facial region in the immediate vicinity of the eye. Acquisition of the periocular biometrics is expected to require less subject cooperation while permitting a larger depth of field compared to traditional ocular biometric traits (viz., iris, retina, and sclera). In this work, we study the feasibility of using the periocular region as a biometric trait. Global and local information are extracted from the periocular region using texture and point operators resulting in a feature set for representing and matching this region. A number of aspects are studied in this work, including the 1) effectiveness of incorporating the eyebrows, 2) use of side information (left or right) in matching, 3) manual versus automatic segmentation schemes, 4) local versus global feature extraction schemes, 5) fusion of face and periocular biometrics, 6) use of the periocular biometric in partially occluded face images, 7) effect of disguising the eyebrows, 8) effect of pose variation and occlusion, 9) effect of masking the iris and eye region, and 10) effect of template aging on matching performance. Experimental results show a rank-one recognition accuracy of 87.32% using 1136 probe and 1136 gallery periocular images taken from 568 different subjects (2 images/subject) in the Face Recognition Grand Challenge (version 2.0) database with the fusion of three different matchers.

Nirgish Kumar [13] Periocular refers to the facial region in the vicinity of the eye, including eyelids, lashes and eyebrows. While face and irises have been extensively studied, the periocular region has emerged as a promising trait for unconstrained biometrics, following demands for increased robustness of face or iris systems. With surprisingly high discrimination ability, this region can be easily obtained with existing setups for face and iris, and the requirement of user cooperation can be relaxed, thus facilitating the interaction with biometric systems. It is also available over a wide range of distances even when the iris texture cannot be reliably obtained (low resolution) or under partial face occlusion (close distances). Here, we review the state of the art in periocular biometrics research. A number of aspects are described, including i) existing databases, ii) algorithms for periocular detection and/or segmentation, iii) features employed for recognition, iv) identification of the most discriminative regions of the periocular area, v) comparison with iris and face modalities, and vi) soft-biometrics (gender/ethnicity classification),. This work is expected to provide an insight into the most relevant issues in periocular biometrics, giving comprehensive coverage of the existing literature and current state of the art. Moreover, we will use different feature extraction techniques such as LBP, PCA, and ICA for pre-processing of periocular biometrics. Comparative Analysis with other competent technologies is also an essential part of this research work.

Felix Juefei-Xu; Marios Savvides [14] The performance of the periocular region is compared with that of full face with different illumination preprocessing schemes. The verification results on the periocular region show that subspace representation on DT-LBP outperforms LBP significantly and gains a giant leap from traditional subspace representation on raw pixel intensity. Additionally, our proposed approach using only the periocular region is almost as good as a full face with only 2.5% reduction in verification rate at 0.1% false accept rate, yet we gain tolerance to expression, occlusion, and capability of matching partial faces in crowds. In addition, we have compared the best standalone DT-LBP descriptor with eight other state-of-the-art descriptors for facial recognition and achieved the best performance. The two general frameworks are our major contribution: 1) a general framework that employs various generative and discriminative subspace modelling techniques for DT-LBP representation and 2) a general framework that encodes discrete transforms with local binary patterns for the creation of robust descriptors.

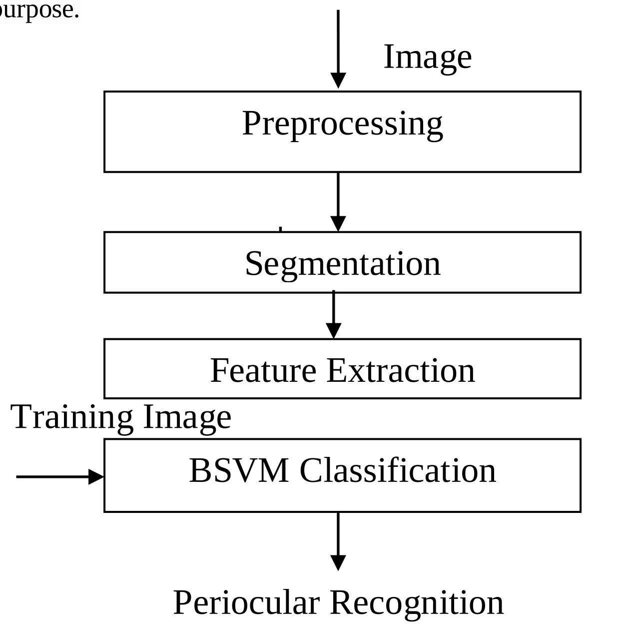
3. PROBLEM DEFINITION

The face is the most widely used biometric trait. Every day and even without noticing it, we all use facial information to recognize each other. Not only that, it becomes one of the most successful applications of image analysis and understanding. Being non-intrusive and allowing cover acquisition, it became preferable over very reliable traits like the iris or fingerprint when aiming at less constrained subject recognition. The periocular region represents a trade-off between the whole face and the iris alone. Containing the eye and its immediate vicinity, it covers eyelids and eyelashes, nearby skin area and eyebrows. Its use as a biometric trait has emerged, constituting nowadays a strong alternative for less constrained environments when image acquisition is not reliable, and to avoid spoofing of the iris patterns. It is easy to acquire without user cooperation and does not require a constrained close capturing, Also, this region is not so affected by the aging process as other facial regions are, as for instance the mouth and cheek whose skin become loosened over time. For the matching accuracy improvement in order to meet the need for large scale real applications, and therefore further research efforts are necessary to advance state-of-the-art performance for periocular recognition.

4. PROPOSED SYSTEM

We attempt to mitigate some of these concerns by considering a small region around the eye as an additional biometric. We refer to this region as the periocular region. In this work, we explore the potential of the periocular region as a biometric in color images. We do not use the near-IR spectrum in this paper, although the eventual goal is to use a multispectral acquisition device that can image the periocular region in both the visible and near-IR spectral bands. The flow of the work Obtaining input image, Preprocessing using Weiner filter, Segmentation using Morphological with foreground detection, Feature extraction using Harlick features algorithm and edge histogram descriptor and Classification using BSVM (Baysien SVM) classifier. This would ensure the possibility of combining the iris texture with the periocular texture. The use of the periocular region has several benefits:

(a) In images where the iris cannot be reliably obtained (or used), the surrounding skin region may be used to either confirm or refute an identity.
(b) The use of the periocular region represents a good trade-off between using the entire face region and using only the iris for recognition. When the entire face is imaged from a distance, the iris information is typical of low resolution; this means the matching performance due to the iris modality will be poor. On the other hand, when the iris is imaged at close quarters, the entire face may not be available thereby forcing the recognition system to rely only on the iris.
(c) The periocular region can offer information about eye-shape that may be useful as soft biometrics.
(d) The depth-of-field of iris systems can be increased if the surrounding ocular region were to be included as well. The purpose of this work is to do a feasibility study on using periocular information as a biometric. Thus, images obtained in the visible spectrum are studied for this purpose.



I. Module description

The input image is loaded for further processing. The input image is converted into grayscale and then weiner filter is applied in order to remove the noise. The preprocessed image is segmented using morphological operations with foreground detection.The morphological opening process is applied for the preprocessed image then the output of morphological processing is used as a masked image to find the foreground. After that masking image is convolved with the original image to segment the foreground.

Haarlick feature

Step1: Segmented image is loaded
Step2: convert the segmented image matrix into the gray level co-occurrence matrix.
Step3: Then the haarlick features like Energy, Contrast, Correlation, Variance, Inverse Difference Moment, Sum Average and Sum Variance are calculated

II. Edge Histogram Descriptor

Step1: Segmented image is loaded.
Step2: divide the image into 4*4 blocks
Step3: Calculate the local edge histogram
Step4: percentage of the number of pixels that correspond to an edge histogram is calculated.
Step5: Calculated the global edge histogram by applying the same procedure described in step 3 on the entire image and then calculate the percentage of the number of pixels that correspond to a global edge histogram bin.
Step6: Save both local and global histogram values in feature vector F1.
Step7: return the Feature Vector F1.
It is repeated for training images. Then the training features are saved.
Training features and testing features are fed into the BSVM classifier to recognize the pericular of the authorized person.

5. EXPERIMENTAL RESULT

We present the results of the experiments for validating our proposal using the test set using an image. Images from the CSIP database were converted to grayscale and resized so as to present a fixed number of pixels, necessary for the implementation of all the approaches based on the CNN methodology. Resizing was carried out in such a way that geometrical proportions were kept from the original images.

(a) Dataset details

UBIPr -This database contains 5,126 left and 5,126 right periocular images from 344 subjects, and simulates a less constrained periocular acquisition environment under the visible spectrum. A noticeable amount of images from this dataset present occlusion, off-angle or illumination variation. For the experiments, only left periocular images are used. We employed the same training set of 3,359 images as used in [9] for model learning. The remaining 1,767 left images are used for the test phase for performance evaluation. This database is used for open-world experiments and therefore no subjects are overlapping between the training and test sets.

(b) Platform details

Operating system-Windows 10 (64 bit)

Processor –intel core i5

(c) Tool details

MATLAB 2018a

(d) Description

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include Application development, including Graphical User Interface building. MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. ... In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis. MATLAB features a family of application-specific solutions called toolboxes.

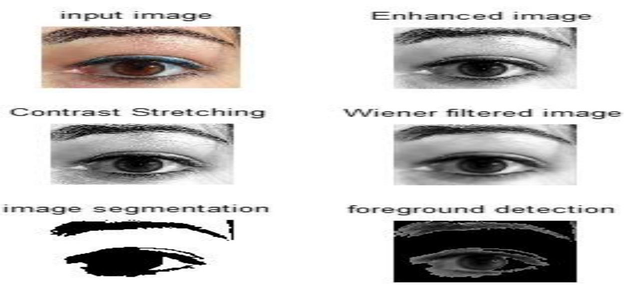


Fig. 1: Experimental Images

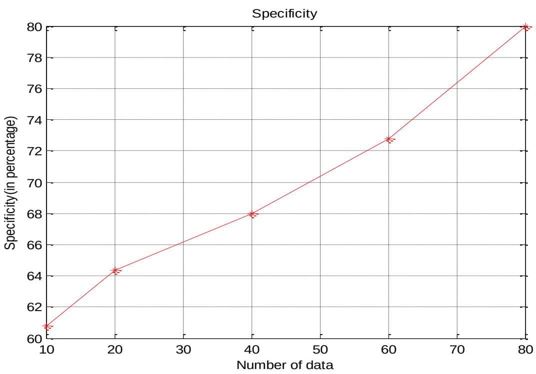


Fig. 2: Specificity vs. number of data

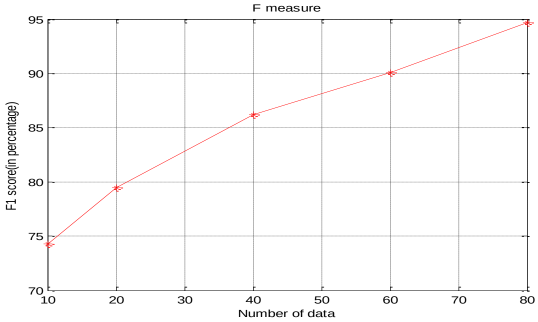


Fig. 3: F measure vs. number of data

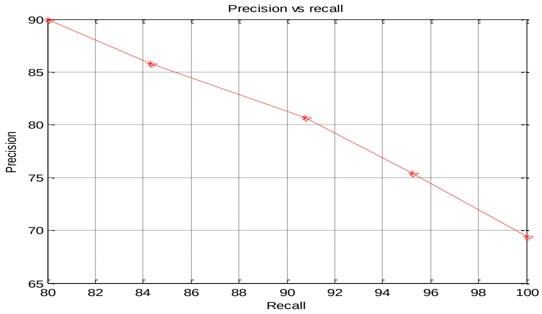


Fig. 3: Precision vs. recall

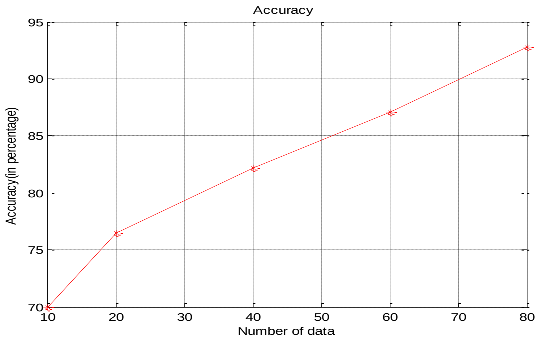


Fig. 4: Accuracy vs. number of data

Table 1: Accuracy comparison

Number of data	10	20	40	60	80
BSVM	70	76.5	82.2	87.1	92.8

Table 2 Recall comparison

Number of data	10	20	40	60	80
BSVM	80	84.3	90.78	95.21	100

Table 3: F measure comparison

Number of data	10	20	40	60	80
BSVM	74.3	79.5	86.2	90.1	94.7

Table 4: Specificity comparison

Number of data	10	20	40	60	80
BSVM	60.8	64.33	68	72.76	80

Table 5: Precision comparison

Number of data	10	20	40	60	80
ANN	69.44	75.43	80.7	85.8	90

Table 6: Execution time comparison

Algorithms	Execution time(in secs)
BSVM	23.96

6. CONCLUSION

Periocular recognition has emerged as a promising trait for unconstrained biometrics after demands for increased robustness of face or iris systems, showing a surprisingly high discrimination ability. It also finds applicability in other areas such as forensics analysis (crime scene images where perpetrators intentionally mask part of their faces). In such a situation, identifying a suspect where only the periocular region is visible is one of the toughest real-world challenges in biometrics. Even in this difficult case, the periocular region can aid in the reconstruction of the whole face. The proficiency to learn robust features from the images makes Baysian support vector machine (BSVM) attractive for recognition. Harlick features and edge histogram descriptor is used to extract the features of training images.

7. REFERENCES

[1] E. Barroso, G. Santos, L. Cardoso, C. Padole, and H. Proenc¸a. Periocular recognition: How much facial expressions affect performance? Pattern Anal. Appl., 19(2):517– 530, 2016

[2] U. Park, R. R. Jillela, A. Ross, and A. K. Jain. Periocular biometrics in the visible spectrum: A feasibility study. In Int. Conf. Biometrics: Theory, Appl., Syst. (BTAS), pages 1– 6, 2009

[3] A. Krizhevsky, I. Sutskever, and H. Geoffrey. Imagenet classification with deep convolutional neural networks. In Int. Conf. Neural Info. Process. Syst. pages 1097–1105, 2012.

[4] G. Levi and T. Hassner. Emotion recognition in the wild via convolutional neural networks and mapped binary patterns. In Int. Conf. Multimodal Interaction pages 503–510, 2015.

[5] K.L. Chang, X. Xiong, F. Liu, and R. Purnomo, “Content-based image retrieval using regional representation,” Multi-Image Analysis, Vol. 2032, pp. 238-250, 2001.

[6] Matti Pietikäinen, “Image analysis with local binary patterns,” Image Analysis, pp. 115-118, 2005.

[7] D. Usher, Y. Tosa, and M. Friedman, “Ocular biometrics: simultaneous capture and analysis of the retina and iris,” Advances in Biometrics: Sensors, Algorithms and Systems, Springer Publishers, pp. 133-155, 2008.

[8] C. N. Padole and H. Proenc¸a. Periocular recognition: Analysis of performance degradation factors. In Int. Conf. Biometrics (ICB), pages 439–445, 2012.

[9] 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

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

[11] Akanksha Joshi, “Periocular Recognition Based On Gabor And Parzen Pnn”, ©2014 IEEE

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

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

[14] Felix Juefei-Xu; Marios Savvides, “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.

[15] U. Park, R. R. Jillela, A. Ross, and A. K. Jain. Periocular biometrics in the visible spectrum: A feasibility study. In Int. Conf. Biometrics: Theory, Appl., Syst. (BTAS), pages 1– 6, 2009.

[16] U. Park, R. R. Jillela, A. Ross, and A. K. Jain. Periocular biometrics in the visible spectrum. IEEE Trans. Inf. Forensics Secur., 6(1):96–106, 2011.

[17] H. Proenc¸a and J. C. Neves. Deep-prwis: Periocular recognition without the iris and sclera using deep learning frameworks. IEEE Trans. Inf. Forensics Secur., 13(4):888–896, 2018.

[18] G. Santos and H. Proenca, "Periocular biometrics: An emerging technology for unconstrained scenarios," in Proc. IEEE Workshop on Computational Intelligence in Biometrics and Identity Management (CIBIM), April 2013, pp. 14-21.

[19] L. Simpson, G. Dozier, J. Adams, D. Woodard, P. Miller, K. Bryant, and G. Glenn. Genetic amp; evolutionary type ii feature extraction for periocularbased biometric recognition. In IEEE Congress on Evolutionary Computation (CEC), 2010, pages 1–4, July 2010.

[20] G. Mahalingam, K. Ricanek, LBP-based periocular recognition on challenging face datasets, EURASIP J. Image Video Process. 36 (2013) 1–13.