Review of Contact Lens Detection in Iris Recognition

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ABSTRACT

Out of many available biometric identification methods, iris recognition seems to be promising and most accurate method. This is because iris structure remains unchanged throughout one's lifetime. One of the live applications of this is: over 1000 ATMs of financial institutions in Chicago and Montreal are now using iris recognition in lieu of debit cards. Imagine the situation if iris recognition systems/scans used in ATMs are fooled or spoofed. Financial system will break with a huge damage. To avoid this, there must exist technique(s) to determine if iris recognition methods are being bypassed.

This paper analyze the same concept of techniques used to detect contact lenses during iris recognition. It has been observed that not all methods can detect all types of contact lenses. Experimental results in this domain show that accuracy of textured lens detection can drop dramatically when tested on a manufacturer of lenses not seen in the training data, or when the iris sensor in use varies between the training and test data.

Keywords- Iris Recognition, Retina, SVM, Biometric.

1. INTRODUCTION

Biometric is the process of identifying people on the basis of their unique biological characteristics which involves biological input, or the scanning or analysis of some part of the body. Iris, fingerprint, DNA are some of the biometric identifiers. Iris is more popular among these identifiers since it is more accurate and unique. It is a thin circular physiological structure in the eye which is generally responsible for controlling the diameter and size of the pupil.

Human iris is formed by early months of age, and it remains unchanged throughout one's lifetime and that's why it is unique. Iris pattern is different for everyone, even for identical twins also. Of all the biometric technologies used for human authentication today, it is accepted that iris recognition is the most accurate.

A circular black disk known as pupil lies in the center of the eyeball which is controlled by the automatic nervous system. The pupil is responsible for adjusting to the amount of light so the size of the pupil varies with respect to the amount of light it is exposed to. The annular ring that is located between the sclera and pupil boundary is called the iris and contains large number of minute details [fig.1]. The iris also has an extremely data rich physical structure and contains the flowery pattern that is unique to an individual. This pattern remains unchanged with age.

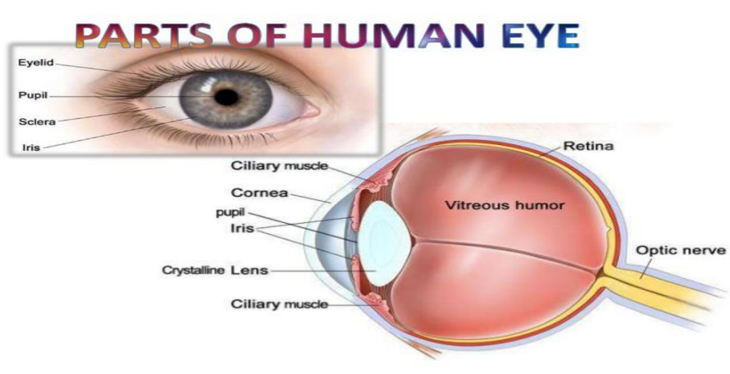

Fig.1 Structure of Human Eye

2. LITERATURE SURVEY

He et al. [2] presented statistical texture analysis based method for detecting fake iris. Four distinctive features based on gray level co-occurrence matrices (GLCM) (mean and standard deviation of pixel values, contrast and the angular momentum) are used as a feature vector. A support vector machine (SVM) is used for classification. They reported the main drawback of the GLCM approach that it needs large storage space. An example of 8-bit image can be considered where the co-occurrence matrix has 65536 elements [2].

Zhaofeng He et al. [3] implemented texture based method for iris spoof detection for contact lens. Firstly, the normalized iris image is divided into sub-regions according to the properties of iris textures. Local binary patterns (LBP) are then adopted for texture representation of each sub-region. Finally, Adaboost learning is performed to select the most discriminative LBP features for spoof detection. A kernel density estimation method is proposed. It is found that LBP is efficient in texture representation and Adaboost algorithm is efficient in learning the most discriminative features for spoof detection. The division of iris into sub regions represents iris texture effectively [3]

Daksha Yadav [4] has shown in experimental results that wearing of contact lenses, both soft contact lense and textured cosmetic contact lense degrades the accuracy of iris recognition. The effect is relatively small increase in the false non-match rate with the clear soft contact lense, but it is major increase in the flase non-matchrate with the textured contact lenses. The problem of lens detection in an iris image is approached as a three class classifiaction problem: no lense, soft lense and textured lense. Three types of experiments were performed such as Intra-sensor validation, inter-sensor validation and multi-sensor validation to evaluate the correct classification rate of the consructed models.

D. Gragnaniello [5] had proposed a new machine-learning technique for detecting the presence and type of contact lenses in iris images. They had extracted the regions of interest for classification, then computed a feature vector based on local descriptors, and feed it to a properly trained SVM classifier by following the usual paradigm. Major improvements are in the current state of the art concern the design of a more reliable segmentation procedure and the use of a recently proposed dense scale-invariant image descriptor. They had experimented results on publicly available datasets. It shows that the proposed method outperforms significantly all other reference techniques.

Textured contact lenses can bypass the biometric systems since they can be used to alter the appearance of iris texture in order to deliberately increase the false positive and, especially, false negative match rates. In order to detect the presence of cosmetic contact lenses, many texture analysis based techniques have been proposed. Existing approaches cannot be said to be promising since they can detect specific lens texture patterns only. In addition to this, these approaches cannot detect/evaluate cosmetic lenses which were created after the approaches were developed. This scenario does not apply in unpredictable practical applications because unseen lens patterns will be experienced in operation for sure. A. Hadid [6] addresses this issue by studying the effect of different iris image preprocessing techniques and introducing a novel approach for more generalized cosmetic contact lens detection. This is based on Binarized Statistical Image Features (BSIF). Their extensive experimental analysis on benchmark datasets shows that the BSIF description extracted from pre-processed cartesian iris texture images gives promising generalization capabilities across unseen texture patterns and different iris sensors with mean equal error rate of 0.14%and 0.88%, respectively. The findings support the intuition that the textural differences between genuine iris texture and fake ones are best described by preserving the regular structure of different printing signatures without transforming the iris images into polar coordinate system.

Hanna Ali [7] presented a complete iris recognition system in which the iris features are obtained using Speeded Up Robust Features (SURF) after enhancing the image using Contrast Limited Adaptive Histogram Equalization (CLAHE). They proposed a novel matching algorithm based on applying fusion rules at different levels which has the advantage of reduced data storage and fast matching. The algorithm is implemented and tested using CASIA(V4) database. They obtained recognition accuracies as 99% using left images and 99.5% using right images. In the result they showed that fusion of right and left images scores increases the recognition accuracy that is why the recognition accuracies obtained after fusion are 99.5% and 100% using minimum and sum rules respectively.

Pedro Silva [8] presented an approach to iris contact lens detection. They focused on a three-class detection problem such as images with textured contact lenses, soft contact lenses and no lenses. In this approach they used a convolutional network to build a deep image representation and an additional fully connected single layer with soft max regression for classification. They conducted experiments in comparison with a state-of-the-art (SOTA) approach on two iris image databases for contact lens detection. These databases are: 2013 Notre Dame(ND) and IIT Delhi Contact Lens Iris Database(IIITD). This approach can achieve a 30% performance gain over SOTA on the former database.

Lovish et al. [9] created a contact lens dataset containing 12823 images acquired from 50 people. For every subject images images are collected without lens, with soft lens and with cosmetic lens class. The authors proposed cosmetic lens detection approach based on Local Phase Quantization (LPQ) and Binary Gabor Pattern (BGP). The results proved that due to blur tolerance of LPQ and robustness of BGP, cosmetic lens detection can be done accurately [9].

Arban Uka [10] proposed a new segmentation technique and two encoding schemes for optimization of iris recognition. Iris recognition is a biometric authentication system which ensures security and has been employed as an important case to test the algorithms developed in pattern recognition. They tested their proposed techniques on CASIA and IIT Delhi database and compared the results with classical segmentation and classical encoding schemes. They prove by using this technique the segmentation is improved and as a result the accuracy and equal error rate also. They shown the result as in CASIA database the use of the new segmentation improves the EER from 3.14% to 0.82% and when tested on complete IIT iris database, the EER is improved from 3.88% to 0.34%; and on the worst images of IIT EER is improved from 13.30% to 1.00%.

3. CONCLUSION

The presence of a cosmetic contact lens is an important issue in iris recognition as it disturbs the natural iris patterns. Differentiating between without lens and transparent lens iris images is a challenging problem. There is a need for a better lens classification approach that can delineate different lens classes correctly. This paper analyzes the different techniques of contact lens detection in iris recognition. Increased accuracy of lens detection algorithms can improve the verification accuracy of iris recognition systems.

References

[1] http://faculty.atu.edu/cbrucker/Engl2053/Samples/Yang13.html

[2] X. He, S. An, and P. Shi(2007), "Statistical texture analysis-based approach for fake iris detection using support vector machines," in Proc. Int. Conf. Adv.Biometrics, 2007, pp. 540-546.

[3] Zhaofeng He, Zhenen Sun (2009), "Efficient Iris spoof detection vis Boosted local binary patterns," LNCS 5558, pp. 1087-1097

[4] D. Yadav, N. Kohli, J. doyle, M. Vasta, R. Singh, "Unraveling the effect of Textured contact lenses on Iris Recognition" IEEE Transactions on IFS, October 2013

[5] D. Gragnaniello, G. Poggi, C. Sansone and L. Verdoliva, "Contact Lens Detection and Classification in Iris Images through Scale Invariant Descriptor," ***2014 Tenth International Conference on Signal-Image Technology and Internet-Based Systems,*** **Marrakech, 2014, pp. 560-565.**

[6] Komulainen, A. Hadid and M. Pietikäinen, "Generalized textured contact lens detection by extracting BSIF description from Cartesian iris images," ***IEEE International Joint Conference on Biometrics,*** **Clearwater, FL, 2014, pp. 1-7.**

[7] Asmaa I. Ismail, Hanna S. Ali, Fathi A. Farag, "Efficient enhancement and matching for iris recognition using SURF" ***2015 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW),*** **Riyadh, 2015, pp. 1-5.**

[8] P. Silva, E. Luz, R. Baeta, H. Pedrini, A. X. Falcao and D. Menotti, "An Approach to Iris Contact Lens Detection Based on Deep Image Representations," ***2015 28th SIBGRAPI Conference on Graphics, Patterns and Images,*** **Salvador, 2015, pp. 157-164.**

[9]Lovish, Aditya Nigam, Balender Kumar and Phalguni Gupta (2015), "Robust Contact Lens Detection using Local Phase Quantization and Binary Gabor Pattern" in 16th Int Conf on Computer Analysis of Images and Patterns (CAIP), Valetta, Malta, Sep 2-4.

[10] A. Uka, A. Roçi and O. Koç, "Improved segmentation algorithm and further optimization for iris recognition," ***IEEE EUROCON 2017 -17th International Conference on Smart Technologies,*** **Ohrid, 2017, pp. 85-88.**