

A Review on Cancelable Biometrics

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Abstract— The Cancelable biometrics is a recent development in biometrics based authentication and identification system. In order to avoid the theft of biometric patterns and to improve the security, it is necessary to adopt non- invertible and cancellable biometric templates. There are some methods with Cancelable and irrevocable nature. This paper is aimed to review the literature on the cancelable biometrics template generation methods. Iris biometric has been considered particularly for the further progress based on the methods of from review.

Keywords—Biometrics, Cancelable biometric templates. Image Embedding technique, Non-invertible Transformation Technique.

I. INTRODUCTION

Biometrics is termed as physiological or behavioral characteristics such as face, fingerprints and iris and behavior characteristics such as voice, gait and keystroke are referred to be unique for every individual [9]. This Biometrics analysis offer best solution to the problem of security and verification.

The one and only problem in biometric analysis is regaining of the individuals pattern by applying any cross matching technique to hack the unique identity [1]. To avoid this type of cross matching, the cancellable techniques are used to revoke the pattern of uniqueness. Every biometric aspect has its own way of cancelable technique [13]. In this paper, section II gives the ideological study of cancelable biometrics, section III reviews the literature of recent cancelable methods, section IV gives the comparative study of existing methods and section V concludes the paper with brief summary and discussion.

II. CANCELABLE BIOINFORMATICS

Now-a-days cancelable biometrics plays a vital role in authentication and verification of uniqueness [1]. Cancelable biometrics means that instead of storing the original template, it is transformed into some other domain to hide the uniqueness of pattern [2]. The only desired property of cancelable templates is to provide no compromise in re-enrollment of pattern using another transformation to find original biometric form. These cancelable methods are used

for different type of biometrics according to their usability [1][5][13].

All the biometrics features are applied with cancelable technique to solution the problem of stealing identity [8]. Recent trends focus on iris biometrics with cancelable property for providing authentication to their uniqueness [2].

III. RELATED WORK

There are many methods to support the purpose of cancel ability in biometrics. In this section, most recently developed cancelable biometric methods are discussed. The GRAY-COMBO with Salting approach [4] are used in iris biometrics to shift and combine rows in unwrapped manner. The uniqueness of pattern can be hidden using Alignment free Cancelable iris biometrics with bloom filter. Then ECC (Error Correction Code) [2] is used to reduce the variability in biometric data. Here shuffling scheme is implied to reduce the hamming distance. ECC reduce the Hamming distance to create the proper accuracy in authentication. Hadamard generated by Sylvester method [2][4].

The comparative analysis of existing methods is given in section IV. This discussion will give dimensions about cancellable parameter in biometrics.

IV. COMPARATIVE STUDY OF METHODS

The security is the major factor of cancelable biometrics in order to avoid the compromise in the level of authentication

[11]. Cancelable strategy is used in all area of biometrics to prevent the uniqueness of pattern [6]. Revocability and Diversity are two most important characteristics of Cancelability [9]. In this Section, a comparative study is

provided with different characteristics of biometric parameter to prove the cancelable and irreversible feature of biometrics in the field of security [3],[7].

Table 1. Comparative Analysis of Cancelable Biometrics

METHODS	BIOMETRICS APPLICATION	PARAMETERS		
		CANCELABLE	IRREVERSIBLE	SECURITY
Registration Free Transforms & Salting Approach [4]	Iris	Good performance	Minimal degradation	Only possible in small database.
Bloom Filter Based Feature Transform[6]	Iris	Multiple cancelable templates of same subject[10]	Mapping column-wise code word	Natural trade -off between security
Hadamard Code & Error correction code. [2]	Iris	Random errors are corrected	Decoding & Error correction are made.	Changing shuffling key[11]
Bio-Hashing Methods[20][5]	Face	feature-based cancelable biometrics	Teoh and Ngo's matching scheme[17][20]	The genuine and impostor distributions
Random Permutation Methods[3]	Face	k- Nearest Neighbor (k-NN) based classification model	Reconstruction of the original biometric template[10]	works very well on multi-view facial database[19]
Knowledge signature in voice recognition[12][16]	Voice	group signature scheme[12]	voiceprint transmitted	Legitimate signatures cannot be generated without factorizing[14]
Block re-mapping in Vein Biometric. [3]	Vein	Image warping approach with different block sizes and offset ranges	Renewable Template Matching Rate (RTMR)	a large integer and the original feature[15]
Histogram Equalization. [6]	Fingerprint	cancelled and reissued	distortion are chosen to be non-invertible	The 256-bit key generated[16]
Huffman Encoding and DCT .[7]	Iris	Good Option	Mesh warping is another non-invertible transformation methods	accuracy of 99.71%, Equal Error Rate of 1.2% and Recognition,Rate of 98.8%.[7]
Surface folding Transform method[9]	Finger print	It performs is better than the Cartesian version and is comparable to the polar version	The nonlinear and discontinuous nature of the transformation	Password and token-based security
CIRF & Chip Matching Algorithm. [8]	Finger print	Chip Matching algorithm	Cyclic cross correlation[18]	Boundary Problem is rectified
Shift-Phase Technique [21].	Finger print	Shifted Phase minutiae	Shifted Phase minutiae , Shuffling, Synthetic points	No original minutiae
Complex Conjugate-Phase (CCP) transform [22].	Finger print	Shifted Phase minutiae with Complex Conjugate value	Shifted Phase minutiae with Complex Conjugate value, Shuffling, Synthetic points	No original minutiae
Reciprocated Magnitude and Complex Conjugate-Phase (RMCCP) transform [23]	Finger print	Shifted Phase minutiae with Reciprocated Magnitude and Complex Conjugate value	Shifted Phase minutiae with Reciprocated Magnitude and Complex Conjugate value, Shuffling, Synthetic points	No original minutiae

In Table 1, the comparison of various cancelable biometric generation methods are done on different aspects. Since the researcher focuses on Iris biometrics, more observations were made on cancelable Iris biometrics. Based on the literature, it is observed that the Huffman Encoding and DCT (Discrete Cosine Transformation) seem to be better in cancelable Biometrics [7].

V. CONCLUSION

This paper concludes the important aspects of cancelable technique. Existing methods are studied and summarized.

This paper will help the research to develop revocable templates using new algorithm to strengthen security with different parameters.

REFERENCES

- [1] Vishal M. Patel, Nalini K. Ratha, et al., "Cancelable Biometrics: A Review". IEEE Signal Processing Magazine, VOL. X, NO. X, MONTH 20XX
- [2] Sanjay Kanade, Dijana Petrovska et al., "Cancelable Iris Biometrics and Using Error Correcting Codes to Reduce Variability in Biometric Data". IEEE, 978-1-4244-3991-2009.
- [3] Emanuela Piciucco, Emanuele Maiorana, et al., "Cancelable Biometrics for Finger Vein Recognition" Section of Applied Electronics, Department of Engineering, Roma, Italy 978-1-4244-2175-6/08, 2008 IEEE.
- [4] Nalini K. Ratha, and Jonathan H. Connell, "Cancelable Iris Biometric". IBM Watson Research Center, 978-1-4244-2175-6/08/\$25.00 ©2008 IEEE
- [5] Dr. E. Chandra and Ms. K. Kanagalakshmi, "Cancelable Biometric Template Generation and Protection Schemes: a Review". IEEE Dept. Of Computer Science, DJ Academy Managerial for Excellence, 978-1-4244-8679-3/11/\$26.00 ©2011.
- [6] Rathgeb, F. Breiting and C. Busch. J. K. Pillai, et al., "Alignment-Free Cancelable Iris Biometric Templates based on Adaptive Bloom Filters". In Proc. IEEE Int'l Conf. on Acoustics Speech and Signal Processing, pages 1838–1841. IEEE, 2010.
- [7] Bismita Choudhury, Patrick et al., "Cancelable Iris Biometrics Based on Data Hiding Schemes". 2016 IEEE Student Conference on Research and Development (SCoReD) 9781-5090-2948-8/16, IEEE.
- [8] Kenta Takahashi, "Cancelable Biometrics With Provable Security And Its Application To Finger Print Verification". IEICETrans. Fundamentals vol. 24A, NO 1, January 2011.
- [9] Nalini K. Ratha, Sharat Chikkerur et al., "Generating Cancelable Fingerprint Templates". Transactions On Pattern Analysis And Machine Intelligence, VOL. 29, NO. 4, APRIL 2007
- [10] Y. J. Chang, Z. Wende, and T. Chen, "Biometrics-based cryptographic key generation," *IEEE International Conference on Multimedia and Expo*, vol. 3, pp. 2203-2206, 2004
- [11] L. Masek, "Recognition of Human Iris Patterns for Biometric Identification". The University of Western Australia, Perth, 2003.
- [12] C. Vielhauer, R. Steinmetz, and A. Mayerhoefer, "Biometric Hash Based on Statistical Features of Online Signatures," Proc. 16th Int'l Conf. Pattern Recognition, vol. 1, p. 10123, 2002.
- [13] N. K. Ratha, J. H. Connell, and R. Bolle, "Enhancing security and privacy in biometrics-based authentication systems", IBM Systems Journal, vol. 40, no. 3, pp. 614–634, 2001.
- [14] Efficient Cancellable Biometric Key Generation Scheme for Cryptography Sunil V. K. Gaddam and Manohar Lal, *International Journal of Network Security*, Vol.11, No.2, PP.61-69, Sept. 2010
- [15] C. Rathgeb and A. Uhl, "A survey on biometric cryptosystems and cancelable biometrics," EURASIP Journal on Information Security, vol. 2011, no. 1, pp. 1–25, 2011.
- [16] B. Chen, and V. Chandran, "Biometric Based Cryptographic Key Generation from Faces," Proceedings of the 9th Biennial Conference of the Australian Pattern Recognition Society on Digital Image Computing Techniques and Applications, pp. 394-401, 2007.
- [17] Teoh, A.B.J., Ngo, D.C.L.: "Cancellable Biometrics Featuring With Tokenised Random Number". To appear in Pattern Recognition Letters (2004)
- [18] P. Lacharme, A. Plateaux, "PIN-based Cancelable Biometrics", International Journal of Automated Identification Technology, Vol. 3, Issue 2, pp. 75-79, 2011.
- [19] M. Savvides, B.V.K. Vijaya Kumar, and P.K. Khosla, "Cancelable Biometric Filters for Face Recognition," Proc. Int'l Conf. Pattern Recognition, pp. 922-925, 2004.
- [20] Teoh, A.B.J., Ngo, D.C.L., Goh, A.: BioHashing: Two Factor Authentication Featuring Fingerprint Data And Tokenised Random Number. Pattern Recognition 37 (2004) 2245-2255.
- [21] K. Kanagalakshmi and E. Chandra, Novel Shift-Phase Transformation based Cancelable and Irrevocable Biometric Template Generation for Fingerprints, International Journal of Computer Applications (0975 –8887), Volume 89 , No 20, pp: 41-53, March 2014.
- [22] K. Kanagalakshmi and E. Chandra, "Novel Complex Conjugate-Phase Transform technique for cancelable and irrevocable biometric template generation for fingerprints", IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 4, No 2, pp: 426-436, July 2012.
- [23] K. Kanagalakshmi and E. Chandra, A Novel Technique for Cancelable and Irrevocable Biometric Template Generation for Fingerprints", Global Journal of Computer Science and Technology Graphics & Vision, Vol. 13, Issue 6, pp.1-11, 2013.

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