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Iris Detection by Discrete Sine Transform Based Feature Vector Using Random Forest

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ABSTRACT

The significance of Iris detection and recognition has been increased from last few decades. Looking at the importance of Iris detection and recognition, we propose a robust, stable and reliable computational model. Three Feature extraction strategies including Discrete Sine Transform (*DST*), Hilbert transform and Fast wavelet Hadamard Transform are used in order to extract numerical descriptors from iris images. Random forest is utilized as a learner. 5-folds cross validation test is applied to evaluate the performance of Random Forest. Among three feature spaces, *DST* feature space has achieved promising results. The success rate of Random forest on *DST* feature space is 93.4%. After examining the results, we have observed that our model might be useful and helpful for iris detection in future work.

KEYWORDS: *DST; FWHT; Hilbert transform; Random forest; 5 folds.*

1. INTRODUCTION

Iris of the human eye is the spherical region having diameter of 12mm located between black pupil and white sclera. Iris recognition provides the most secure techniques for individual identification and detection because of its stable and unique features. None of the two irises are same, even in case of twins. Iris texture varies from person to person and it also provides more stability than other biometrics like fingerprint, face etc. Physical characteristics of iris remain the same for lifetime [1, 2]. Iris based automated systems are currently available in various environment such as airport security, ATMs, physical access security and many more.

Pioneer work on Iris Recognition has been carried out by the John Daugman [3-7]. Sundaram et al., located the inner and the outer circular iris region using Daugman algorithm and Hough transform [8]. Whereas, Birgale et al., decomposed the segmented Iris image through discrete wavelet transform up to levels 3. Matching of iris images are performed using Euclidian distance [9]. Tuama et al., proposed an algorithm for detecting and segmenting the iris and pupil boundary [10]. Similarly, Surveet et al., extracted the feature from normalized iris image using one dimensional Discrete Sine Transform and neural network employed for classification. The proposed technique is assessed on both the CASIA and Bath database [11]. Likewise, Patilet et al., introduced lifting wavelet transform approach to extract features from CASIA iris images. Recognition rate is evaluated by measuring the Euclidian distance between two iris templates [12]. Cuiet et al., presented a synthesis approach with *PCA* on the iris images. Super-resolution is used to enhance the quality of the synthesis images [13]. Huanget et al., used independent component Analysis (*ICA*) to extract features from iris images and competitive learning mechanism to identify pattern [14]. In a sequel, Monroet et al., used discrete cosine transform on both *CASIA* and Bath iris datasets and obtained the recognition rate of 100% [15].Whereas, Kekreet et al., generated wavelet transform from orthogonal component transforms of various sizes. It was investigated that *DCT* achieved the better results compared to other methods [16].

In this paper, we presented a computational model for iris recognition. Features are extracted using three different approaches such as Discrete Sine transform (DST), Fast Walsh hadamard transform (FWHT) and Hilbert transform. Random forest is utilized as a hypothesis learner. *MMU* iris database is used to evaluate the recognition rate of the classifier.

The remaining paper is organized as follows: Feature extraction methods and classification algorithm are described in Section2. Section 3 presents Results and discussion .Finally conclusions are drawn in the last Section.

2. MATERIALS AND METHODS

2.1) Dataset description:

In order to develop a computational model, the first step is to select a suitable and appropriate benchmark datasets are required to train and test the model. In this regards, we have utilized a *MMU*1 iris database to evaluate the performance of the proposed method [23]. MMU contains 450 images that are equally labeled into two different classes of left and right iris images. All the images are stored in BMP format and having image resolution of 320*240 pixels.

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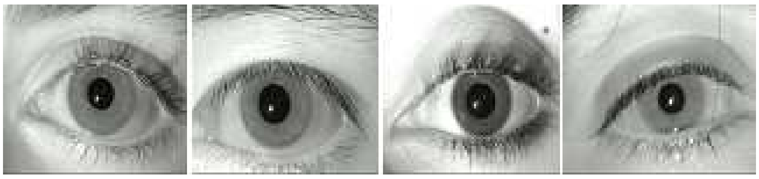

Fig. 1. Sample Iris images from MMU

2.2) Discrete Sine Transform (DST):

DST is a kind of Sinusoidal and separable Transform. It is quite equivalent to Discrete Fourier Transform but it uses only real part of the matrix. *DST* produces orthogonal matrix [17; 18]. DST is defined as follows:

$$X_K = \sum_{i=1}^{N} X_n Sin\left[\frac{\pi}{N+1} \cdot (n * K)\right] \quad (1)$$

Where X_K is the real value *DST* coefficient, *K* is factors that adjust the sine Vector and *N* represents the number of input elements.

2.3) Hilbert Transform (HT)

Hilbert transform is a key tool of signal processing and is used as a frequency domain transform. Applying Hilbert Transform frequency of the signals do not changed [19]. In this paper, Hilbert transform is used to extract important features from iris images. The Hilbert transform for a function X (t) is defined as:

$$H[X(t)] = \frac{1}{\pi} \int_{-\infty}^{\infty} \frac{x(\tau)}{t-\tau}\, d\tau \quad (2)$$

2.4) Fast Walsh Hadamard Transform (FWHT)

In computational mathematics, FWHT is an efficient algorithm to calculate the Walsh hadamard transform (*WHT). FWHT* is computational better than *WHT* [20; 21]. In image processing *FWHT* is used for image compression and filtering. Hadamard transform is a real, symmetric and orthogonal. The Walsh hadamard transform is defined as:

$$H(n) = \begin{bmatrix} H(n-1) & H(n-1) \\ H(n-1) & -H(n-1) \end{bmatrix} \quad (3)$$

2.5) Random forest

Random forest is the classification algorithm that is commonly used in machine learning; data mining and pattern recognition. Random forest predicts the data by constructing decision trees at training phase. Each tree depends on the value of a random vector sampled independently with same distribution of trees in the forest [22;27-29]. Random forests efficiently execute lager datasets, comparing other classification algorithm random forest is less sensitivity to the used parameter.

2.6) Proposed Method

In this work we extracted the features from iris images by applying three different methods such as *DST*, *FWHT* and Hilbert Transform. For investigating the recognition rate, Random forest is utilized as learner.5-folds cross-validation test is employed to assess the performance of the classifier. Block diagram of the proposed computational model is depicted in figure 2. Various performance measures are applied to determine the discrimination power of the learning algorithm, are mention below.

$$Accuracy = \sum_{i=1}^{k} \left({}^{TPi}/_{N}\right) \quad (4)$$

$$Sensitivity = \left(\frac{TP}{TP} + FN\right) * 100 \quad (5)$$

$$Specificity = \left(\frac{TN}{FP} + FN\right) * 100 \quad (6)$$

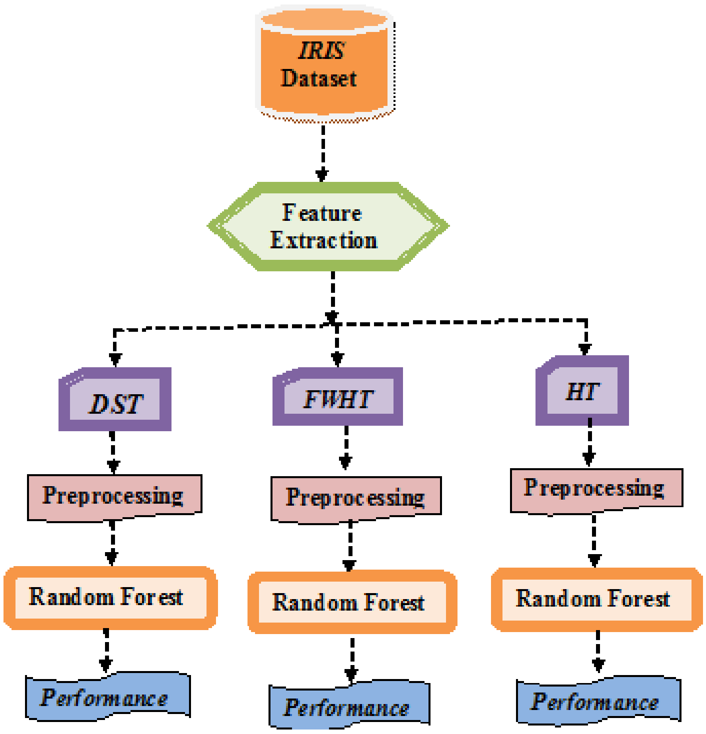

Fig. 2. Framework of the Propose Model

3. RESULTS AND DISCUSSION

In classification, different cross validation tests are used [30]. In our case we used 5-folds cross validation test to evaluate the performance of the proposed model. One fold is used for testing purpose and the remaining folds are used for training. The whole process is repeated 5 times and finally the results are combined.

The prediction rates of the proposed model using all the three feature space are depicted in Table 1. Random forest achieved the highest accuracy of 93.4% with sensitivity, specificity of 92.2% and 94.5% using *DST* feature space. On other hand, *FWHT* feature space obtained an accuracy of 87.9%, sensitivity of 89% and specificity of 87%.The accuracy using Hilbert transform is 86.4% with sensitivity, specificity of 88.2% and 85.9%. The empirical result reveals that *DST* concentrated more energy based on only few coefficients as compared to other transforms techniques.

Table1. Performance rates of Random forest using 5-folds

Proposed techniques	*Acc %*	*Sen%*	*Sp%*
DST	**93.4**	**92.2**	**94.5**
FWHT	**87.9**	**89**	**87**
Hilbert	**86.4**	**88.2**	**85.9**

(Acc= Accuracy, Sen: Sensitivity, Sp: Specificity)

The comparison of proposed model and already existing approaches has been drawn in Table 2. The proposed model of Harioko et al [24] has obtained an accuracy of 87.26%, whereas the proposed model of Ibrahim et al [25] has yielded an accuracy of 91%. Similarly, Perez et al proposed model has obtained 84% accuracy. In contrast, our proposed model has achieved 93.4% accuracy, which better than already existing approach. This achievement is ascribed with the discrimination power of DST and generalization capability of Random Forest.

Table2. Performance Comparison with Existing Approaches

Methods	*Success Rate*
Harjoko et al.,[24]	87.26%
Ibrahim et al.,[25]	91%
Perez et al.,[26]	84%
Proposed Method	93.4%

4. CONCLUSION

In this paper, we proposed an efficient, stable and reliable security system for iris recognition. Three numerical descriptor extraction schemes namely: *DST, FWHT* and Hilbert transform are used to extract features from Iris database. Random forest is utilized as classification learner. The performance rate of the learner algorithm is assessed using 5 folds cross validation test. The experimental results illustrate that *DST* based feature space has achieved the highest success rate of 93.4% compared to other feature extraction schemes. It is anticipated the proposed model might be useful security based application and helpful for further research.

REFERENCES

1. Jain. A.K, R. Bolle and S. Pankanti Eds., Biometrics: Personal Identification in a networked Society. Norwell, MA: Kluwer, 1999.
2. Jain. A. K, A. Ross and S. Prabhakar, "An Introduction to Biometric Recognition" IEEE Trans. on Circuits and System for Video Tech., Vol.14, No.1, 2004, p. 4 -20.
3. Daugman.J, "High confidence personal identification by rapid video analysis of iris texture ", Proc. Of the IEEE, International Carnahan conference on security technology, 1992.
4. Daugman.J, "High confidence visual recognition of persons by a test of statistical independence", IEEE Trans. Pattern Anal. Machine. Intell, Vol.No:15, November 1993, p. 1148–1161.
5. Daugman.J, "Uncertainty relation for resolution in space, spatial frequency, and orientation optimized by two-dimensional visual cortical filters," Journal of the Optical Society of America A, vol. 2, no. 7, 1985, p.1160-1169.
6. Daugman. J, "Biometric personal identification system based on iris analysis," US Patent Number US5291560, 1994.
7. Daugman. J, "The importance of being random: Statistical principles of iris recognition," Pattern Recognition, vol. 36, no. 2, 2003, p. 279-291.
8. Sundaram. R. M, C.B. Dhara and B. Chanda," A fast method for iris localization", Second Int'l Conf. on Emerging Applications of Information Technology (EAIT) IEEE 2011, p.89-91.
9. Birgale. L. V and M. Kokare, "Iris Recognition Using Discrete Wavelet Transform", Int'l. Conf. on Digital Image Processing, 2009IEEE, p. 147-151.
10. Tuama. A. S," Iris Image Segmentation and Recognition", Int'l. Journal of Computer Science Emerging Tech, Vol-3 –No. 2 April, 2012, p. 60-65.
11. Surve. N and A. Kulkarni, Iris Recognition using Discrete Sine Transform and Neural Network", Int'l Conf. and Workshop on Emerging Trends in Technology (ICWET), 2010, p.750-755.
12. Patil. C. M. and S. Patilkulkarani, "Iris Feature Extraction for Personal Identification using Lifting Wavelet Transform", Int'l Journal of Computer Applications, Vol.1-No. 14, 2010, p. 68-72.
13. Cui. J, Y. Wang, J. Huang, T. Tan and Z. Sun, "An Iris Image Synthesis Method Based on PCA and Super-resolution", Proc.17th Int'l Conf. Pattern Recognition, vol.4, 2004, p. 471-474.
14. Huang. YP, SW. Luo. S and Ey.Chen, "An Efficient Iris Recognition System", Proc. Int'l Conf. Machine Learning and Cybernetics, vol. 1,2002, p. 450-454.
15. Monro.DM, S. Rakshit and D. Zhang," DCT-Based Iris Recognition", IEEE Trans. on Pattern Analysis and machine intelligence, Vol.29, No.4, 2007,p. 586-595.
16. Kekre. H.B, T. Sarode and P. Natu, "Image Compression using Wavelet Transforms of DCT, DST, Hartley and Real-DFT with Variation in Size of Component Transforms", Int'l. Journal of Scientific & Engineering Research, Volume 4, Issue 10, 2013, p.512-517.
17. Ying. W.X., and L. Yang, "Comparison of 3-D Discrete Cosine and Discrete Sine Transforms for the Novelty Estimation in Volumetric Data ",Int'l. Journal of Computer and Information Technology,Vol.3 – Issue 02,2014,p.193-198.
18. http://en.wikipedia.org/wiki/Discrete_sine_transform.
19. Sridhar. G. V and P. M. Rao ,"A Neural Network approach for EEG Classification in BCI", Int'l. journal of Comp.Science And telecom.,Vol.3,Issue 10,2012,p.44-48.

20. Sasikala. D and R. Neelaveni ,"Registration of Brain Images using Fast Walsh Hadamard Transform" ,Int'l Journal of Computer Science and Information Security, Vol. 8, No. 2, 2010,p.96-105.
21. http://en.wikipedia.org/wiki/ Fast Walsh-Hadamard transform.
22. Breiman.L, "Random Forests", Machine learning, 2001, Vol.45, Issue 1, p. 5-32.
23. The MMU1 Iris Image Database [Online]. Available: http://pesona.mmu.edu.my/~ccteo
24. Harjoko. A, S. Hartati and H. Dwiyasa," A Wavelet Based Iris Recognition Method".
25. Ibrahim. M, J.S. Soraghan and N. A. Manap, "Iris Localisation Using Fuzzy Centre Detection (FCD) Scheme and Active Contour Snake", Jurnal Teknologi (Sciences & Engineering),Vol. 69,No.6, 2014, p.73-77.
26. Perez .D, C. Fernandez, C. Segura and J. Hernando "New Approaches for Iris Boundary Localization", VI Jornadas de Reconocimiento Biométrico de Personas 2012, p.64-72.
27. FAROOQI, W., ALI, S, and WAHAB, A "Classification Of Dengue Fever Using Decision Tree", VAWKUM Transaction on Computer Sciences, Vol.3,No.2, 2014,p. 15-22.
28. Hayat, M., Khan, A. WRF-TMH: Predicting Transmembrane Helix by Fusing Composition index and physicochemical properties of Amino Acids, Journal of Amino Acid 44(5):1317-28, 2013
29. Hayat, M. Khan, A. Yeasin, M., Prediction of Membrane Proteins Using Split Amino Acid Composition and Ensemble Classification, Journal of Amino Acids (2012) 42:2447–2460
30. Hayat, M Iqbal, N., Discriminating of Protein Structure Classes by Incorporating Pseudo Average Chemical Shift and Support Vector Machine, Journal of Computer Methods and Programs in Biomedicine, 116 (3), 184-192, 2014