Efficient iris image compression using curvelet transform

A. Saranya Devi (Pg Scholar) [1], B. Annapoorani (Assistant professor) [2]
[1,2]*Department of Computer Science and Engineering*
[1,2]*KLN College of Information Technology,Pottapalayam, TamilNadu, India*
spknr1812@gmail.com [1] , Annapoorani.prasath@gmail.com [2]

Abstract-Iris recognition system for identity authentication and verification is one of the most precise and accepted biometrics in the world. Portable iris system mostly used in law enforcement applications, has been increasing more rapidly. The portable device, however, requires a narrow-bandwidth communication channel to transmit iris code or iris image. Though a full resolution of iris image is preferred for accurate recognition of individual, to minimize time in a narrow bandwidth channel for emergency identification, image compression should be used to minimize the size of image. This Paper describes the approach to Iris Image Compression using the curvelet Transform. Wavelets, though well suited to point singularities have limitations with orientation selectivity, and therefore, do not represent two-dimensional singularities (e.g. Smooth Curves) effectively. This paper employs the curvelet transform in combination with Lifting Wavelet Transform and Huffman Coding for iris image compression, which exhibits good approximation properties for smooth 2D iris images. The main objective of our work is to develop an efficient iris image compression scheme in order to compress iris images in a lossless manner. Iris image is compressed for different Image sizes and the results are analyzed using Compression ratio, Bits per Pixel Value and Objective Quality Metrics.
Keywords—irisrecognition;image compression; peak signal to noise ratio(PSNR); curvelet decomposition; compression ratio(CR)

I.INTRODUCTION

Image compression plays an essential role for effective transmission and storage of images. Televideo conferencing, medical imaging, document processing, remote object sensing etc. are the most significant applications of image compression.[1]. Requirements for storage, management and transfer of digitized image, have grown explosively using digital cameras. These stored image size can be very big and can use a lots of memory of the storage device. For example a 512x512 gray image has more than 50,000 components available for storage; on the other hand an ideal color image that is 640 x 480 pixels has closely a million elements. It is very time consuming job to copy or download these records from the internet servers. Indian government launched "Aadhaar" program in 2010 to collect the biometric categorizing features specifically iris patterns for nearly about 1.2 billion Indian residents [2]. This system storage is too high to manage including database transferring over internet or designing a portable device to carry. This actually leads us to compress iris image without loss of iris features. It is also necessary to measure the recognition performance of compressed iris image [3], [4]. In general image occupies the vital portion of bandwidth for communication. Therefore the improvement of efficient image compression technique has turned into quite compulsory [5]. The fundamental aim of image compression is to remove redundancy and omitirrelevancy. Redundancy helps to remove redundancy from the signal source and irrelevancy omits pixel values which are not noticeable by the human eye. Iris recognition system using a biometric method. The biometric methods are used in Face recognition system, Finger prints, Hand geometry, Retina, Iris, Signature, Vein and Voice. This paper can be organized as follows. The next section discussed the related works of image compression in case of iris recognition system. Third section familiarizes the different forms of image compression technique based on curvelet transform.

II. RELATED WORKS

Compression technique can be applied to image to reduce their storage size and transmission time. There are two kinds of compression such as Lossless and lossy compressions. During the last few years several image compression techniques have been developed in biometric system like iris recognition system. Different types of image compression standards like JPEG, JPEG-2000 and JPEG-XR have been utilized to generate the compact iris data [2], [3], [4]. Daugman proposed JPEG compression technique with region of interest isolation. He adopted his method in one database [2]. R.W Ives investigated the result of image compression and performance of iris recognition scheme along with JPEG-2000 compression technique [12]. Funk et al. investigated and discussed the impact of JPEG, JPEG-2000 (ISO/IEC 15444), fractal, PRVQ image compression on cross over accuracy of biometric system [13]. But the JPEG technique computes the DCT of 8x8 blocks taken from the original eye image. But sometimes JPEG is not suitable for high compression rates. Another limitation is that the blocking artifact that can occur at high compression ratio. This paper has proposed a suitable iris image compression technique using different curvelets that can be applied in iris recognition system. The curvelet transform is a powerful way to represent iris image. Decompression level selection of curvelet transform is also an important task, because computational complexity depends on it. The curvelet transform, exhibits smooth iris images.

III. IMAGE COMPRESSION

A. Discrete Curvelet transform

Two approaches of Discrete Curvelet transform namely Wrapping Method and Un equal spaced Fast Fourier Transform(USFFT) method, the Wrapping Method is faster and easier to implement than the USFFT method, while having the same result as USFFT method. The wrapping method assumes a regular rectangular grid to wrap the object. The idea is to first decompose the

B. Lifting wavelet transform

- Lifting scheme is a rather new method for constructing wavelets. The main difference with the classical constructions is that it does not rely on the Fourier transform.
- In this way, lifting can be used to construct second-generation wavelets. The basic idea behind the lifting scheme is very simple; one tries to use the correlation in the data to remove redundancy.
- At first the data is split into two sets (Split phase): the odd samples and the even samples.
- N even samples are used to predict the value of a neighbouring odd value (Predict phase).
- The third step (Update phase) updates the even samples using the newly calculated odd samples such that the desired property is preserved

C. Huffman algorithm

Variable length encoding of symbols Exploit statistical frequency of symbols Efficient when symbol probabilities vary widely. Use fewer bits to represent frequent symbols Use more bits to represent infrequent symbols.

IV. FLOW DIAGRAM OF THE PROPOSED METHOD

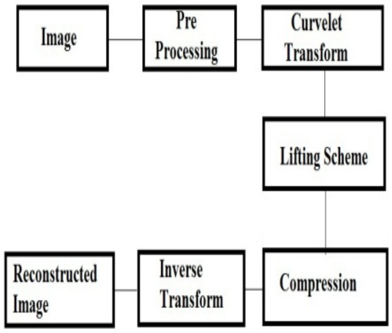
The proposed method of iris compression with the fusion of curvelet transform, lifting scheme, compression and inverse transform can be described in the following flow diagram**.** It provides the exact information of the edges and curved surfaces of the iris images. Better compression ratio and PSNR value.

image into a set of frequency bands, and to analyse each band by a curvelet transform. The block size can be changed at each scale level

A. Wrapping DCT Algorithm

Take FFT of the Image.
Divide FFT into collection of Digital Tiles.
For each tile

- Translate the tile to the origin
- Wrap the parallelogram shaped support of the tile around a rectangle centered at the origin.
- Take the inverse FFT of the wrapped support.
- Add the curvelet array to the collection of curvelet coefficients.



V. SIMULATION RESULTS

Images from CASIA [9] and MMU [10] database have been used for evaluating the performance parameters like PSNR, BPP etc. of the compressed image. The variations of hamming distance for the various compressed image have also been observed.

A. CASIA and MMU Database

CASIA-Iris version 4 contains six subsets. They are CASIA Iris Interval, CASIA Iris Twins, CASIA Iris Distance, CASIA Iris Lamp, CASIA-Iris-Syn. and CASIA-Iris- Thousand. Genuine and virtual are two subjects of CASIA-Iris version 4 where total iris image is about 54,601 [9]. MMU1 database consists of 450 iris images which were captured by a specific camera named LG Iris access 2200. On the other hand, MMU2 iris database contains a total number of 995 iris images [10]. Figures shows the simulation results of the proposed method. The histogram of the original image is approximately same to the histogram of the compressed image that can be obtained to compress the decomposed image applying CRA, MSE and PSNR techniques. Two levels Huffman coding and lifting is suitable than three or four level decomposition in our proposed method without minimum loss of information. The original image size is 12.3 KB where the compressed image size is 7.42 KB in the above figure. IWT provides better compression ratio for higher decomposition levels.

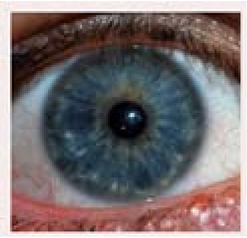


Figure 1: Original IRIS

Figure 2: IWT

Figure 3: Gray Scale

Figure 4: Compressed Image

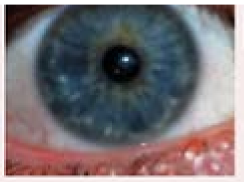


Figure 5: Pre-processing

Figure 6: Inverse IWT

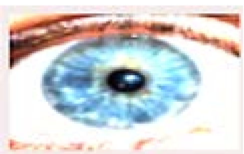


Figure 7: Curvlet Transform

Figure 8: Reconstructed Image

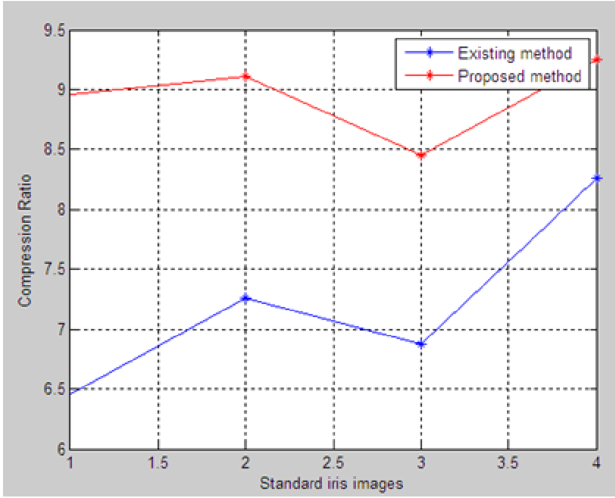


Figure 9: Compression Ratio Analysis

Standard Iris Image	Existing Compression Ratio	Proposed Compression Ratio
1	6.456	8.956
2	7.2548	9.1156
3	6.8745	8.4518
4	8.2584	9.2548

Table 1

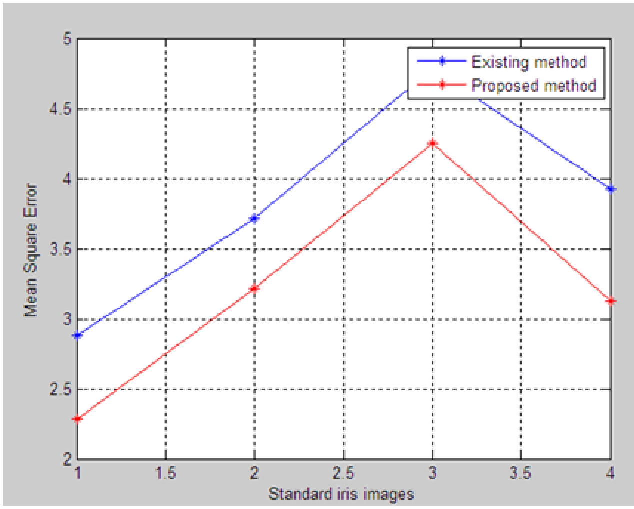


Figure 10: MSE

Standard Iris Image	Existing MSE	Proposed MSE
1	2.2855	2.8855
2	3.215	3.715
3	4.254	4.7854
4	3.125	3.925

Table 2

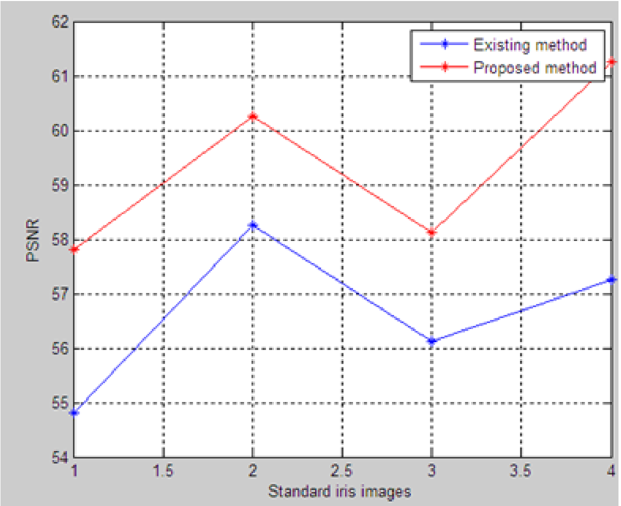


Figure 11: PSNR Analysis

Standard Iris Image	Existing PSNR	Proposed PSNR
1	54.8019	57.8019
2	58.2548	60.2548
3	56.1251	58.1251
4	57.258	61.258

Table 3

VI. CONCLUSION

IWT has been shown that it is well suited for iris image compression for its high compression ratio. Consequently, compression does not decrease the security of iris recognition systems, but “only” reduces user convenience. This paper has investigated the effects of iris image compression while the recognition system is used a commercial iris recognition algorithm along with curvelet transform coding by applying PSNR, STW and EZW technique. The matching performance is attributed to noise reduction without a significant loss of texture. It has also been ensured that the iris-matching algorithms are not degraded by image compression techniques. As a result large size of iris database can be reduced to small size that can be handled in a portable device and minimally affected the matching purpose.

REFERENCES

[1] John Daugman and Cathryn Downing, "Effect of Severe Image Compression on Iris Recognition Performance,” IEEE Transactions on Information Forensics and Security, Vol.3,Issue: 1, 2008

[2] John Daugman, "600 million citizens of India are now enrolled with biometric ID,” SPIE Newsroom, 7 May 2014, SPIE Newsroom. 10.1117/2.1201405.005449

[3] S. Rakshit and D. M. Monro, “An evaluation of image sampling and compression for human iris recognition,” IEEE Trans, Inf. Forensics Security, vol. 2, no. 3, pp. 605–612, Sep. 2007.

[4] Robert W Ives, DanielA Bishop, Yingzi Du and Craig Belcher, “Iris Recognition: The Consequences of Image Compression,” EURASIP Journal on Advances in Signal Processing, 2010.

[5] J. Zuo, N. A. Schmid, and X. Chen, “On generation and analysis of synthetic iris images,” IEEE Trans. Inf. Forensics Security, vol. 2, no.1, pp. 77–90, Mar. 2007.

[6] Xiaofeng Wu, Shigang Hu, Zhiming Li, Zhijun Tang, Jin Li, Jin Zhao, “Comparisons of Threshold EZW and SPIHT Wavelets Based Image Compression Methods,” Indonesian Journal of Electrical Engineering, Vol.12, No.3, pp. 1895 ~ 1905, March 2014.

[7] E. Christophe, C.Mailhes, P. Duhamel, “Hyperspectral Image Compression: Adapting SPIHT and EZW to Anisotropic 3-D Wavelet Coding,” IEEE Transactions on Image Processing ; Vol 17, pp. 2334– 2346, 2008.

[8] Shapiro J.M. “Embedded image coding using zero trees of wavelet coefficients,” IEEE Trans. Signal Proc., Vol. 41, No.12, pp. 3445-3462, 1993.

[9] “CASIA Iris Image Database,” http://biometrics.idealtest.org/

[10] “MMU Iris Image Database: Multimedia University,” http://pesonna.mmu.edu.my/~ccteo/

[11] C. Belcher and Y. Du, “A selective feature information approach for Iris image-quality measure,” IEEE Transactions on Information Forensics and Security, vol. 3, no. 3, pp. 572– 577, 2008.

[12] Ives, R.W., Broussard, R.P., Kennell, L.R., Soldan, D.L.:, “Effects of image compression on iris recognition system performance,” J. Electron. Imag. 17, 011015.1–8 ,2008.