iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** VIII **Month of publication:** August 2016

DOI:

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Comparative Analysis of Hybrid DKT-DCT with DKT and DCT in Image Compression

Tamanna B. Ghodke[1], Diwate S.R[2]
Department of E & TC, Pune University

Abstract— Image compression is one of the prominent applications of image processing. It has triggered the need of data compression so that volume of data and bandwidth required to transmit it can be reduced. Still image compression is an important part of data compression. This paper proposes various image compression method using different transforms. Discrete cosine Transform (DCT) is one of the transform applied on image individually and Discrete Kekre Transform (DKT) is also one of the transform applied on image individually. Hybrid transform is generated by combining the properties of any two transforms. In this paper we proposes the two hybrid transforms namely Hybrid DKT-DCT transform and Hybrid DWT (Discrete Wavelet Transform)-DKT transform. Next the hybridization of two transform is applied on images. Hybrid DKT-DCT transform give better energy compaction than individual transform. It combines properties of both, Kekre transform and DCT. But Hybrid DWT-DKT gives high compression ratio.

Keywords— DCT; DKT; Hybrid DKT-DCT transform; Mean Absolute error; SSIM; PSNR.

I. INTRODUCTION

Image compression is also one of the important applications of image processing. High volume of data is unavoidable in our day to day life when one deals with audio, digital images and videos. Image compression has point out the need of data compression. So in data transmission bandwidth required to transmit it can be reduced. Still image compression, is an important part of data compression to reduce the volume of data. Basic objective of compression is reduces number of bits to represent the image. Image compression is basically divided in to two parts. One is Lossless compression, it gives reconstructed image exactly matches with original image. Therefore it gives very low compression ratio. Compression ratio is the ratio of compressed image bits to the original image bits. This ratio is generally used to measure the performance of any compression method. High compression ratio shows the better image compression. Second is Lossy compression, which gives compressed image is approximately similar to original image [1]. Lossy compression gives the degradation in image quality. Hence optimization in compression ratio and image quality is necessary. Image compression techniques based on many transform have been studied in literature review. DCT have high energy compaction property. Therefore it is used in large scale for the compression[2]. Compression using other transform like Walsh transform [3], Haar transforms, Hartley transform [4] has also been studied in recent literature review. In DCT transform image is represented into different frequency components. These components are high frequency component and low frequency component .But DCT transform uses Low frequency components and concentrated at top left corner in matrix which gives high energy compaction, achieve compression and scattered high frequency components can be eliminated. DCT is popularly used in JPEG compression. DCT transform convert image from spatial domain to frequency domain. Normally DCT is applied on NxN blocks of an image. It results in blocking artifacts at high Compression ratio [11]. In last decades Wavelet transform is another technique that has gained more popularity. Wavelet transforms is provide time frequency analysis of a signal. Unlike DCT wavelet can be applied on whole Image which reduces the chances of blocking artifacts. Wavelets show high energy compaction than DCT [13 10]. In proposed method, the hybrid DKT-DCT transform, generated from Discrete Kekre Transform (DKT) [16] and DCT. To improve the performance of compression the Hybrid DCT-DKT transform is proposed and it gives the better compression than other compression transforms. Next section gives the literature review of different transforms in image compression.

II. REVIEW OF LITERATURE

The literature survey is carried out by different IEEE journals, E-medias, national and international conference paper, research journals etc.

In paper “Performance Superiority Of Hybrid DKT-DCT Wavelet Compared To DKT, DCT Individual Transforms and Their Wavelets In Image Compression” by H.B. Kekre and Tanuja Sarode, in 2014 5th International Conference- Confluence. The Next Generation Information Technology Summit (Confluence), they propose simple and novel image compression method using transforms. Discrete cosine Transform (DCT) and Discrete Kekre Transform (DKT) both are applied on image individually. By

using Kekre's algorithm of wavelet generation, wavelet transform of DCT and DKT is generated. Wavelet transform gives better energy compaction than individual transform. It is reflected in reconstructed image quality of wavelet transforms. Further implement the hybridization of two transform is used and hybrid wavelet transform using DKT and DCT is generated and applied on images. It combines properties of both, DKT and DCT. Hybrid wavelet transform gives less error than wavelet transform and individual orthogonal transform.

In the paper "Image Compression Using the Discrete Cosine Transform" by *Andrew B.* in Mathematica Journal, 4(1), 1994, p. 81-88, *Watson.* The discrete cosine transform (DCT) is a technique widely used in image compression for converting a signal into elementary frequency components. In this technique they develop some simple functions to compute the DCT and to compress images. These functions illustrate the power of *Mathematica* in the prototyping of image processing algorithms.

In the paper "Query based Image Retrieval using Kekre's, DCT and Hybrid wavelet Transform over 1st and 2nd Moment" by H. B. Kekre and Kavita Sonawane. In International Journal of Computer Applications (0975 – 8887) Volume 32– No.4, October 2011. In this paper, they describe the novel techniques to retrieve similar images from large volume of databases based on contents. Hybrid Wavelet and Kekre's transform are gives better results as compare to DCT transform. Especially if we compare the computational time required for these three transform to extract the feature vector for database or the query images Kekre's transform and hybrid wavelet transform are taking less time as compare to DCT transform.

In the paper "Robust Watermarking Technique Using Hybrid Wavelet Transform Generated from Kekre Transform and Discrete Cosine Transform" by Dr. H. B. Kekre, Dr. Tanuja Sarode, Shachi Natu. This paper presents a novel image watermarking technique using Kekre's algorithm to generate hybrid wavelet transform DKT-DCT from Kekre transform and Discrete Cosine Transform. In the proposed technique, Performances of these three ways of applying transform are compared against various image processing attacks namely image compression, image resizing, image cropping, and adding noise attacks.

In the paper "Digital Image Compression using Hybrid Transform with Kekre Transform and Other Orthogonal Transforms" by H.B. Kekre, Tanuja Sarode, Prachi Natu, in IOSR Journal of Computer Engineering (IOSR-JCE) (Jan 2014) they presents image compression technique using hybrid transform. Concept of hybrid wavelet transform can be extended to generate hybrid transform. RMSE is calculated for different compression ratios to check the performance of hybrid transforms. Various orthogonal transforms like DCT, Walsh, Slant, Hartley, Real-DFT and DST are combined with Kekre transform to generate hybrid transforms. DKT-DCT gives better image quality and lower RMSE than other pairs formed with DKT.

In the paper "Jpeg Image Compression Using Discrete Cosine Transform - A Survey" by A.M.Raid, W.M.Khedr, M.A.El-dosuky and Wesam Ahmed, in International Journal They obtain that Image compression is needed. This paper is a survey for lossy image compression using Discrete Cosine Transform (DCT), it explain JPEG compression algorithm which is used for full colour, still image applications and describes all the components of it.

III. PROPOSED METHODS

Proposed methods for image compression is Hybrid DKT-DCT and utilizes the idea of producing hybrid transform from three orthogonal transforms DWT, DCT, DKT

Volume 4 Issue VIII, August 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

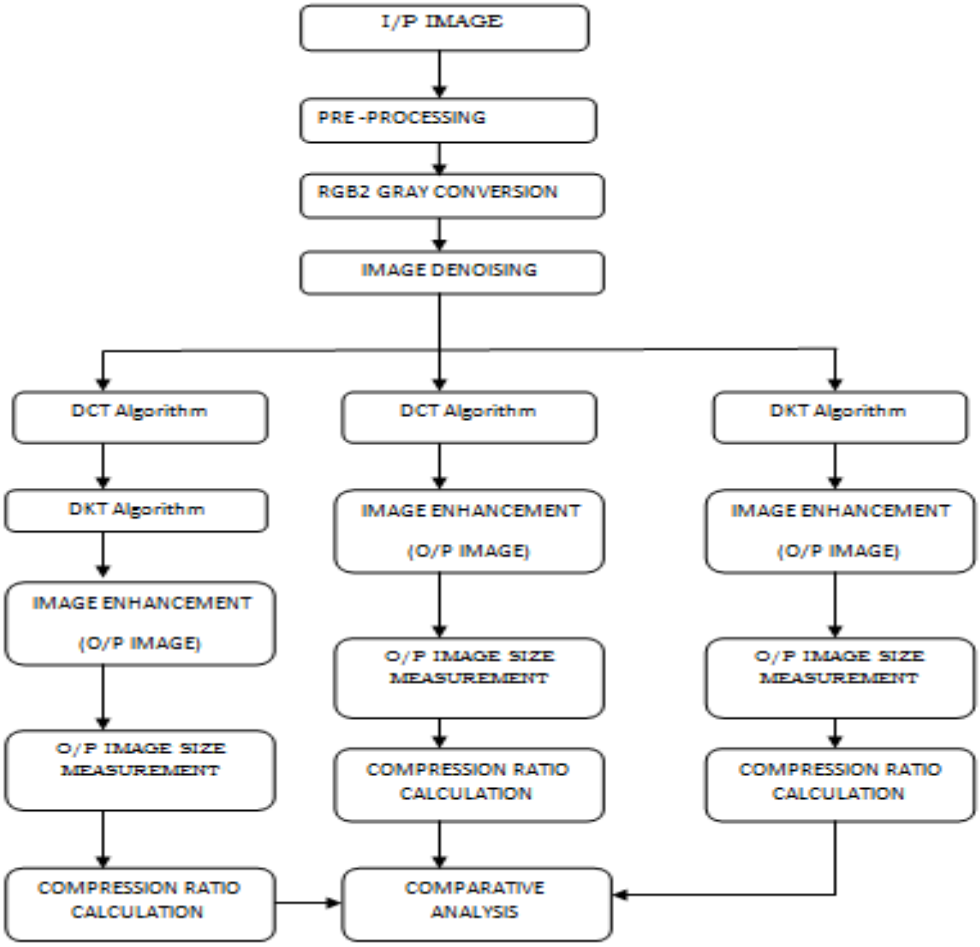


Fig 1: Flowchart for image compression and comparative Analysis.

A. Kekre Transform

The advantage of Kekre's transform matrix is, it need not be of size having integer power of 2. It can be of any size NxN. All upper diagonal and diagonal elements of Kekre transform are 1 whereas; all lower diagonal elements except the elements just below the diagonal are zero. Kekre transform matrix is obtained by using following equation,

$$K_{XY} = \begin{cases} 1 & x \le y \\ -N+(x-1) & x = y+1 \\ 0 & x > y+1 \end{cases} \quad (1)$$

Kekre transform matrix obtained using eq. 1 is

$$K = \begin{bmatrix} 1 & 1 & 1 & \ldots & 1 \\ -N+1 & 1 & 1 & \ldots & 1 \\ 0 & . & . & \ldots & . \\ . & . & . & \ldots & . \\ & 0 & 0 & 0 & \ldots & 1 \\ 0 & & 0 & 0 & -N+(N-1) & 1 \end{bmatrix} \quad (2)$$

Volume 4 Issue VIII, August 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

B. Discrete Cosine Transform

DCT coefficients are used for JPEG compression. It separates the image into parts of differing importance. It converts a signal or image from the spatial domain to the frequency domain. It can separate the image into high, middle and low frequency components [7] and also image is broken into 8×8 blocks of pixels. Working from left to right, top to bottom, the DCT is applied to each block. Each block is compressed through quantization table to scale the DCT coefficients and message is embedded in DCT coefficients.

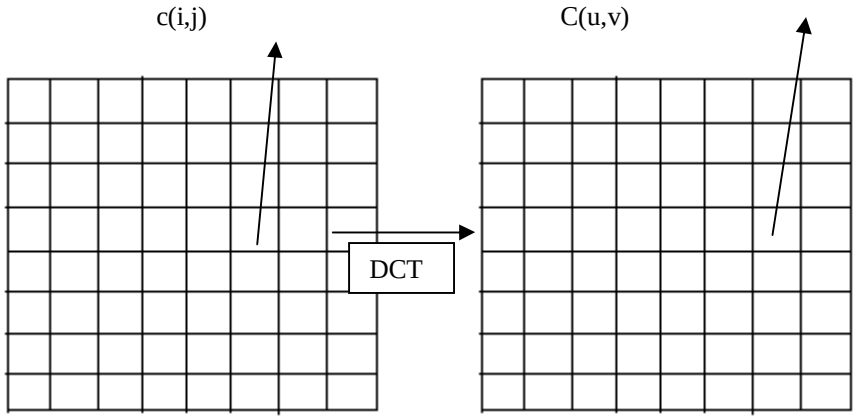


Fig. 1: Discrete Cosine Transform of an Image

DCT coefficients are used for JPEG compression. It separates the image into parts of differing importance. It converts a signal or image from the spatial domain to the frequency domain. It can separate the image into high, middle and low frequency components [7] and also image is broken into 8×8 blocks of pixels. Working from left to right, top to bottom, the DCT is applied to each block. Each block is compressed through quantization table to scale the DCT coefficients and message is embedded in DCT coefficients.

C. Discrete wavelet transform

Wavelet transform decompose a signal into component wavelets. One particular wavelet may generate a more sparse representation of a signal than another, so different kinds of wavelets must be examined to see which is most suited to image compression. Wavelets are better suited to time-limited data and by reducing errors, wavelet based compression technique maintains better image quality.

D. Hybrid Transform

In Kronecker product given by using eq. 3 first 'p' rows contribute to global features and remaining (p*q)-p rows contribute to local features. Number of rows giving global features can be varied to 2*p.

$$T_{AB} = \begin{bmatrix} A_p \otimes B_q(1) \\ A_p \otimes B_q(2) \\ I_p \otimes B_q(3) \\ . \\ . \\ I_p \otimes B_q(n) \end{bmatrix} \qquad (3)$$

Here A_p is Kekre Transform matrix of size pxp. and B_q is DCT matrix of size qxq. Resultant hybrid wavelet matrix will be of size pqxpq i.e.256x256 in this case which is equal to size of images chosen for experimentation. B_q (1) indicates first row of B. $A_p \otimes B_q$ (1) gives first 'p' rows of hybrid wavelet matrix focusing on global features of an image. Identity matrix is used for shifting of rows in second matrix i.e. DCT. Thus it gives local properties of an image.

$$T_{AB} = A_P \otimes B_P [a_{ij}[B]]_{pq*pq} \qquad (4)$$

Where a_{ij} is individual element in transform matrix A.

Volume 4 Issue VIII, August 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

IV. RESULT AND DISCUSSIONS

Fig. 3 Set of test images from Different Classes

Fig. 3 shows the set of test images. In pre-processing of image compression firstly we use the image and by using the flowchart we perform the different operation on image. In first step of image compression is taking the test image and converts it into RGB to Gray format. In second step we want to get the pure gray image therefore by using filtering we get this gray image. After filtering process we want to resize the image. After resizing image apply the different transform on same image and finally compare the performance of different transform.

After pre-processing apply the different transform method DCT, DKT, Hybrid DCT-DKT and Hybrid DWT-DKT on image to compress the image. After compression we find the different parameter to observe the performance of each transform for the comparison.

TABLE 11. COMPARATIVE ANALYSIS BETWEEN PROPOSED METHODS

Parameters	Proposed methods apply on first image			
	DCT	DKT	Hybrid DKT-DCT	Hybrid DWT-DKT
MSE	128.338	128.338	122.476	132.407
PSNR	27.0473	27.0473	27.2503	26.9117
SSIM	0.233682	0.233694	0.445425	0.192526
Compression ratio.	73.93	101.098	102.191	557.546

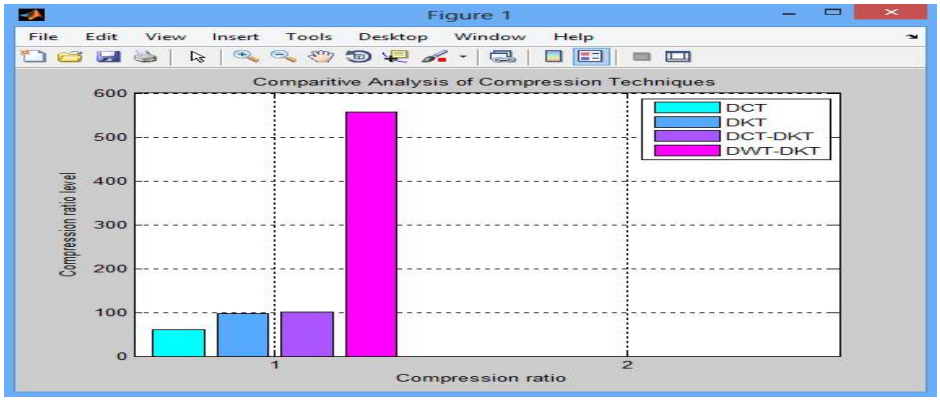


Fig 4: Experimental Results of Compression Ratio for different compression techniques

Volume 4 Issue VIII, August 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

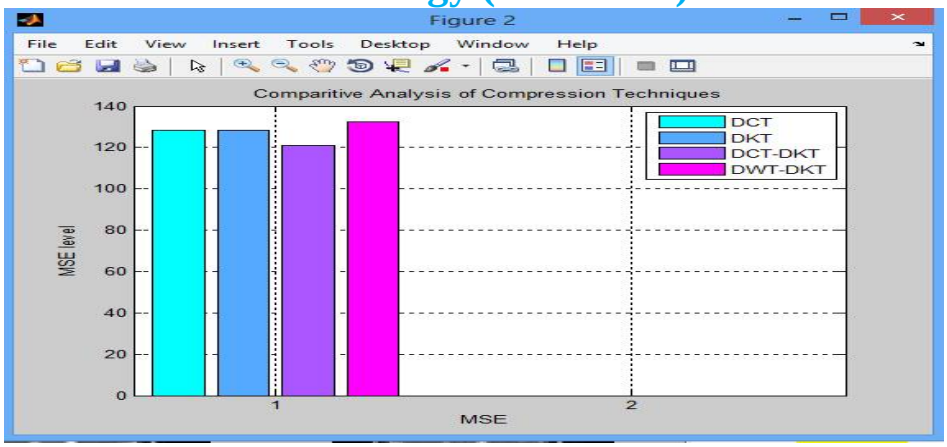


Fig 5: Experimental Results of MSE for different compression techniques

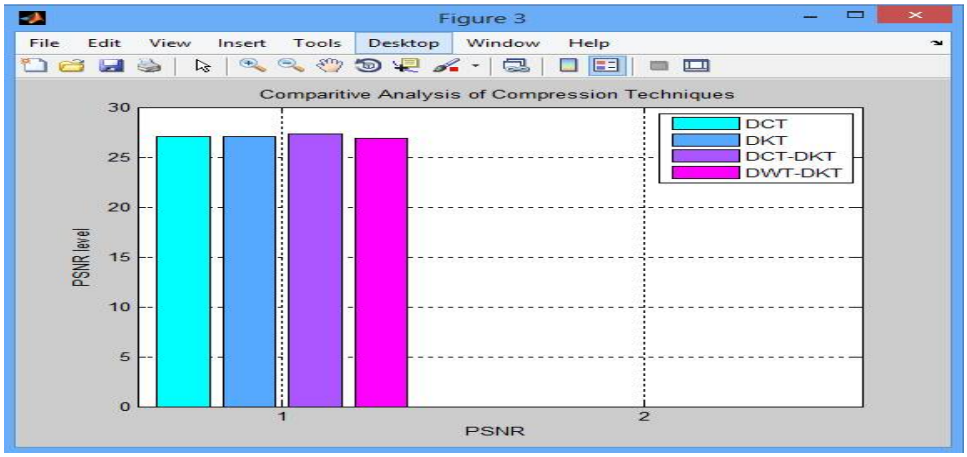


Fig 6: Experimental Results of PSNR for different compression techniques

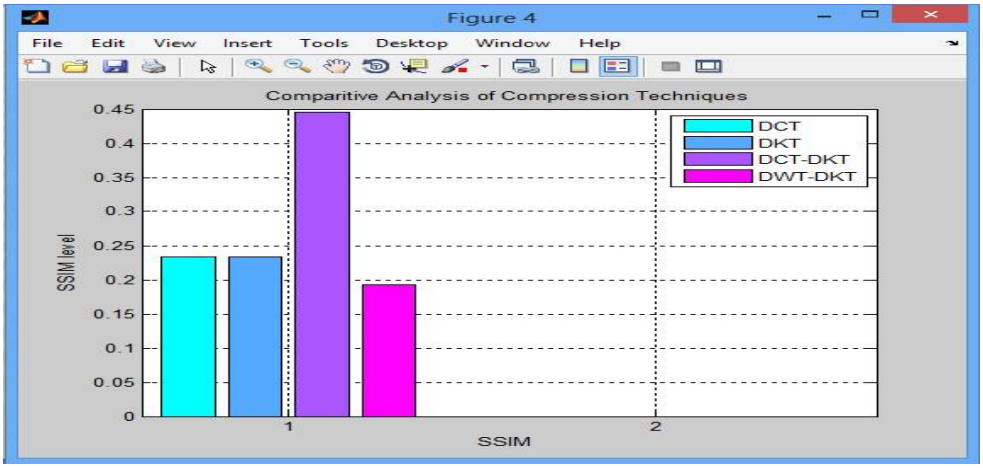
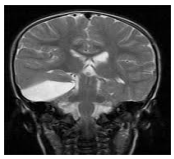
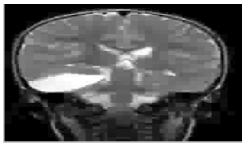
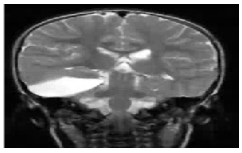
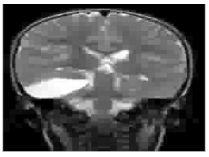
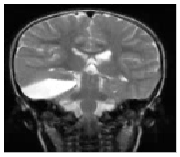


Fig 7: Experimental Results of SSIM for different compression techniques

Table 1 shows different transform for image compression with different parameters MSE, PSNR, SSIM and Compression ratio for first image and Fig.4 Fig.5 Fig.6 Fig.7shows experimental results of Compression ratio, MSE, PSNR and SSIM respectively for different compression techniques. MSE (Mean square error) is the cumulative squared error and the original image, whereas PSNR is a measure of the peak error. Lower value for MSE means lesser error and as seen from the inverse relation between the Mean Square Error (MSE) and PSNR this translates the high value of PSNR. Therefore logically, a higher value of PSNR is shows that the ratio of signal to noise is higher and it is good. Higher compression ratio means it gives the image is highly compressed image.

Volume 4 Issue VIII, August 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

TABLE2. COMPARISON OF DIFFERENT TECHNIQUE FOR DIFFERENT IMAGE

Comparison for Image 6(.tiff)				
Original image	DCT	DKT	Hybrid DCT-DKT	Hybrid DWT-DKT
				
MSE	196.91	196.91	192.072	200
PSNR	25.1881	25.1881	25.2962	25.1205
SSIM	0.0410042	0.041032	0.143426	0.032049
CR	40.5826	92.6876	101.3	1573.85
Comparison for Image 7(.jpg)				
Original image	DCT	DKT	Hybrid DCT-DKT	Hybrid DWT-DKT
				
MSE	250.917	250.917	250.9	251.256
PSNR	24.1355	24.1355	24.1358	24.1296
SSIM	0.0108934	0.0109162	0.0109126	0.00977708
CR	34.5081	79.9002	101.323	696.851

V. CONCLUSION

This paper proposes the comparative analysis of hybrid DKT-DCT with DCT and DKT in image compression. From Experimental results we conclude that Hybrid DKT-DCT transform gives better performance than other transforms but Hybrid DWT-DKT gives better compression. Results show that Hybrid DKT-DCT has low MSE and High PSNR. It also have compression ratio is high as compare to DCT and DKT but less than Hybrid DWT-DKT. Therefore Hybrid DKT-DCT is better than other transforms and Hybrid DWT-DKT gives high compression ratio. If we want to consider only image compression then Hybrid DWT-DKT is better.

REFERENCES

[1] "Performance Superiority Of Hybrid DKT-DCT Wavelet Compared To DKT, DCT Individual Transforms and Their Wavelets In Image Compression" by H.B. Kekre and Tanuja Sarode, in 2014 5th International Conference- Confluence.

[2] H. B. Kekre, Tanuja Sarode, Prachi Natu, "Performance comparison of hartley transform with hartley wavelet and hybrid hartley wavelet transforms for image data compression" , International Journal of Computers and Technology (IJCT), Vol. 12, No. 6, pp. 3634-3641. Jan 2014

[3] R. Mehala, K. Kuppusamy, "A new image compression algorithm using haar wavelet transformation ", In Proc. of International Conference on Computing and information Technology (IC2IT), International Journal of Computer Applications, pp. 1-4, 2013.

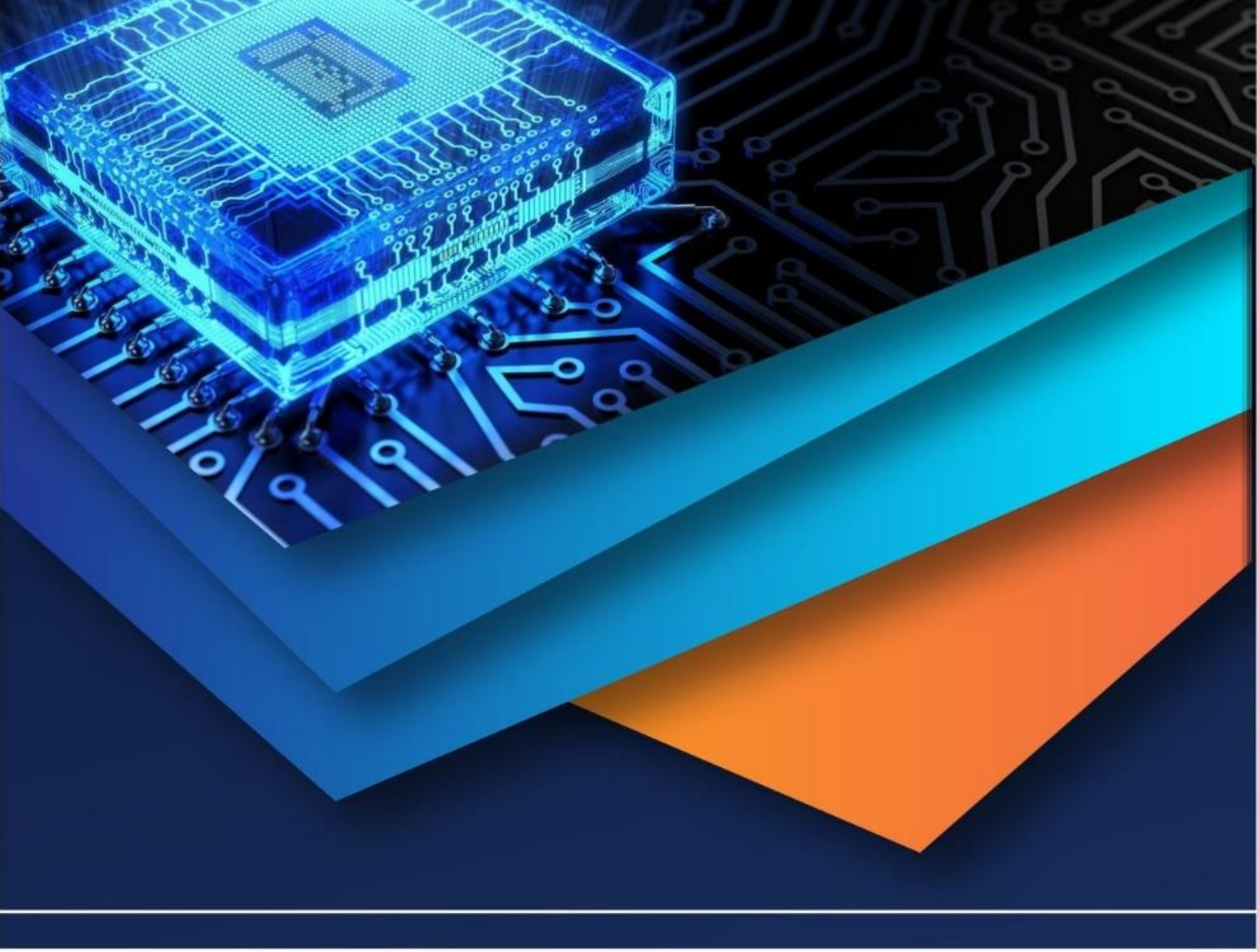
[4] Shawki A. Al Dubaee, Nesar Ahmad, "Multilingual lossy text compression using wavelet transform", First IEEE International Conference on Integrated Intelligent Computing, pp.39-44, 2010,.

[5] Su C.K., Hsin H.C, Lin S.F., "Wavelet tree classification and hybrid coding for image compression" IEE Proceedings on Vision, Image and Signal Processing, Vol. 152, No. 6, pp. 752–756, Dec. 2005

[6] R. S. Stankovic and B.J. Falkowski, "The haar wavelet transform: its status and achievements", Computers and Electrical Engineering, Vol. 29, No.1, pp. 25-44, Jan. 2003

[7] Karagodin M. A., Osokin A. N., "Image compression by means of walsh transform", 8th International scientific and practical conference of students, post-

graduates and young specialists, pp. 173-175, 2002.
[8] Sonja Grgic, Mislav Grgic, and Branka Zovko-Cihlar, "Performance analysis of image compression using wavelets", IEEE Trans. Industrial Electronics, Vol. 48, No. 3, pp. 682-695, June 2001
[9] Omer Nezih Gerek, A. Eniscetin, "Adaptive poly phase decomposition Structure for image compression", IEEE Trans. on Image Processing, Vol.9 (10), 2000
[10] Z. Xiang, K. Ramchandran, M. T. Orchard, and Y. Q. Zhang, "A comparative study of DCT- and wavelet-based image coding," IEEE Trans. on Circuits Syst. Video Technology, vol. 9, pp. 692–695, Apr.1999
[11] S. Bauer, B. Zovko-Cihlar, and M. Grgic, "The influence of impairments from digital compression of video signal on perceived picture quality", 3rd International Workshop Image and Signal Processing, pp. 245–248, 1996.
[12] Strang G. "Wavelet transform versus fourier transform", Bulletin of American Math. Society 28, pp. 288-305, 1993.
[13] A. S. Lewis and G. Knowles, "Image compression using the 2-D wavelet transform", IEEE Trans. on Image Processing, vol. 1, pp.244–250,1992.
[14] Daubechies, I. "The wavelet transform, time-frequency localization and signal analysis", IEEE Transformation and Information Theory 36: pp.961-1005, 1990
[15] Ahmed, N., Natarajan T., Rao K. R.: "Discrete cosine transform", IEEE Trans. on Computers, Vol. 23, pp. 90-93, 1974
[16] Bradley, S.D, "Optimizing a scheme for run length encoding", In Proc. of the IEEE., vol. 57, no. 1, pp. 108–120, Jan. 1969.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY