International Journal of Electronics and Communication Engineering.
ISSN 0974-2166 Volume 6, Number 3 (2013), pp. 217-224

http://www.irphouse.com

A Survey on Hybrid Image Compression Techniques for Video Transmission

Reny Catherin L.[1], Thirupurasunthari P.[2], Sherley Arcksily Sylvia A.[3], Sravani Kumari G.[4], Joany R.M.[5] and N.M. Nandhitha[6]

[1, 2, 3, 4] *IV Year ECE, Sathyabama University, Jeppiaar Nagar, Chennai- 600 119.*
[5]*AP/ECE, Sathyabama University, Chennai.*
[6]*Prof., ECE, Sathyabama University, Chennai*
katherin.reny@gmail.com, thivya.parthasarathi93@gmail.com, sylvia.sherley@yahoo.com, sravanig09@gmail.com, nandhi_n_m@yahoo.co.in, mariajoany@gmail.com.

Abstract

With the advent of internet, large number of images is transmitted. Memory space and channel capacity are the major challenges during image transmission. Hence image compression plays a major role during image transmission. Considerable research is carried out in the literature in both spatial and transform domain. Performance metrics used are Peak Signal to Noise Ratio (PSNR) and Compression Ratio (CR). In this paper an extensive literature survey is done on various image compression techniques.

Keywords: DCT, DWT, Neural Network, Huffman Coding, SPIHT, Quantization.

I. INTRODUCTION

Image Compression aims at removing coding, inter pixel and psycho visual redundancies. In order to remove coding redundancy, different symbol encoders namely Huffman Coding, Run length Coding and Arithmetic Coding are used. LZW coding is used for removing interpixel redundancy. Improved Gray Scale Quantization is used for removing psycho visual redundancy. While the former two techniques result in lossless compression, the later leads to lossy compression. Image compression can be performed directly in the spatial domain or in the transform domain. Transform coding techniques involve sub image separation, forward transformation, Quantization and symbol encoding at the transmitter's side. At the receiver's end symbol decoding is done. Inverse transformation is involved. Lossless compression does not involve quantization and is mainly used in medical image transmission. Video conferencing is achieved by lossy compression technique.

This paper is organized as follows: Section II describes Discrete Wavelet Transform (DWT) based image compression techniques; Section III provides Hybrid Image Compression Techniques using Discrete Cosine Transform (DCT) and DWT. Section IV describes SPIHT based compression techniques. Section V discusses Artificial Neural Network (ANN) based image compression techniques. Section VI concludes the work.

II. DWT BASED IMAGE COMPRESSION TECHNIQUES

Prasanthi Jasmine et al (2012) proposed wavelet and ridgelet based compression methods. Methodology involved is: the RGB image is converted to gray scale and is de-noised with Gaussian filter; Discrete Wavelet Transform (DWT) is performed on the de-noised image; Finite Ridgelet Transform (FRT) is employed to obtained wavelet coefficients; compressed image of reduced size is obtained; decompression is done by applying Inverse FRT and DWT and the original image is obtained without loss of data. This hybrid image compression technique results in compression of the image in an effective manner without losing data. Indrit Enesi (2012) proposed a combination of wavelet technique with algebraic Generalized Principal Component Analysis (GPCA) that provides compression of multimedia information without reducing its quality. The proposed algorithm is as follows: Load the RGB image; wavelet transform is applied to the image; the approximation co-efficient will be decomposed into a sub-band tree; Hybrid Linear Modeling is performed on the approximation coefficients; Entropy encoding is executed to obtain the compressed image; Reconstruction of the image is done by reverse process. Performance of the proposed method is better than the classic wavelet method and achieves a higher performance. PSNR-values were found to be 15% larger. Praveen Kumar and Sumithra (2013) proposed a technique for image compression using Multi-wavelets in medical applications and stated that it has better efficiency and the computing complexity is reduced. The steps are: the input image is converted into 256x256; color image is converted to gray scale; feature extraction is done; input image data is segmented and transformed to a set of features; for decompressed image binary encoding is implemented. The proposed algorithm for image compression using the multi-wavelet transform has inferred that it has reduced mean square error is reduced (MSE) and high compression ratio (CR). Meenakshi Chaudhary and Anupma Dhamija (2013) proposed a new compression technique by combining Modified Fast Haar Wavelet Transform (MFHWT) and Symlet wavelet through Singular Value Decomposition (SVD) method. The steps involved are: Load the gray scale image as a matrix; Apply Hybrid wavelet on the image; Compute the approximation and detail coefficients matrices by Hybrid Wavelet decomposition; Apply SVD on approximation coefficients matrix to obtain sub band; Reconstruction is done by reverse process. This proposed method and the compression technique like MFHWT provide results that are best for image compression.

III. HYBRID IMAGE COMPRESSION TECHNIQUES USING DCT AND DWT

Aree Ali Mohammed and Jamal Ali Hussein (2011) presented a scheme for medical image compression based on hybrid compression technique (DWT and DCT) to achieve higher compression rates. The proposed technique is as follows: Load the RGB image and convert into YC_bC_r; to obtain approximate 8x8 coefficient bands apply Forward Discrete Wavelet Transform (FDWT); Perform Forward Discrete Cosine Transform (FDCT) on the image and apply DCT and DWT quantization; Discrete Pulse Code Modulation (DPCM) is implemented to convert the bands into positive values and Variable Shift Coding algorithm is employed; Reconstruction is done by the reverse procedure. Experimental results show that these images preserve its quality where quantization factor is less than 0.5. Parveen Banu and Venkatramani (2011) proposed a hybrid image compression scheme which comprises of three techniques for efficient storage and delivery of data. The original color image is converted into luminance and chrominance components. The luminance component is decomposed by one level Daubechies-4 wavelet transform. Lifting wavelet scheme is applied on the chrominance component. DWT based decomposition and lifting scheme were applied on gray scale image. As coarse component has less correlation and detail component has more correlation, Huffman encoder encodes the coarse component with more number of bytes and detail with lesser number and then compressed file is obtained. Performance of the proposed technique is evaluated in terms of Compression Ratio (CR), Bits per pixel (BPP) & Peak Sound to Noise Ratio (PSNR) and is compared with different methods. It is inferred that the proposed technique produces higher compression ratio with lesser bits per pixel for both gray and color images of different sizes. Bheshaj Kumar et al (2012) proposed a hybrid image compression technique by combining JPEG algorithm and Symbol Reduction Huffman technique to obtain more compression ratio. The methodology involves the following techniques: Input the image to be compressed and divide the source image into 8X8 sub blocks; Convert the divided image into a gray scale level between [-128 to 127] and apply DCT on each sub image; The coefficients were quantized and the less significant coefficients are set to zero; Further zigzag ordering is applied and the coefficients of increasing frequency are obtained; Finally, the remaining values are quantized by the proposed entropy encoder. It is inferred that this Hybrid JPEG image compression scheme was found to have 20% more compression ratio than in Standard JPEG image compression. Harjeetpal Singh and Sakhi Sharma (2012) presented a hybrid image compression method by combining Discrete Cosine Transform (DCT) and Discrete Wavelet Transform (DWT) and compared the results with stand alone DCT and DWT algorithms. The methodology involves the following steps: Acquired original image is divided into 16X16 blocks and 2D Discrete Wavelet Transform (DWT) is applied. Second level of dcomposition is performed using DWT. On the approximation co-efficients, 2D Discrete Cosine Transform is applied. Approximation co-efficients are then encoded using Huffman Transform. At the reciever's end, the image is reconstructed. This Hybrid compression scheme results in higher compression ratio and Peak Signal to Noise Ratio (PSNR) which makes it highly suitable for telemedicine and wireless capsule.

Sriram and Thiyagarajan (2012) proposed a hybrid DWT-DCT technique which performed better than standalone DWT and DCT. The methodology used is as follows: RGB model is converted to YC_bC_r color model; image is split into blocks of size 32 x 32; decomposition is done by 2D Forward DWT in two stages and approximation coefficient bands are obtained; 8-point DCT is then applied to these DWT coefficients; quantization is performed where the higher frequency components are rounded off to zero; Arithmetic coding technique is applied; Laplacian enhancement is done to obtain fine details of the image. It is inferred that the coding scheme gives high compression ratio without reducing much quality of the image. The new scheme reduces blocking artifacts, ringing effects and false contouring appreciably. Ali Moustafa Alsayyh and Dzulkifli Mohamad (2012) found that hybrid technique using DCT and DWT gives better performance when compared to other techniques. The methodology used in this technique is as follows: the source image is divided into 8x8 or 16x16 blocks; for each sub block 2- D Discrete cosine transform (DCT) is implemented and the DCT coefficients are quantized, coded and transmitted; Simultaneously on the other side the image is converted into single compressed image; DWT will be implemented on the compressed single image where low pass filters are applied in the rows and columns which generates approximation band. Manisha Singh and Agom Das Goswami (2012) suggested a hybrid scheme by combining DWT and DCT algorithm to lower the transmission and storage cost of image compression. The procedure is as follows: The original RGB images are transformed to Luminance – Chrominance by performing compression process; Image is decomposed using DWT with Haar transform; the 2x2 adjacent pixels are passed through the four filters; Reconstruct the image by the same four 2D filters. Hence the proposed algorithm performs better than the existing methods and can be used in image compression applications that requires high compression ratio. Ramandeep Kaur Grewal and Navneet Randhawa (2012) developed a robust DWT-DCT algorithm for image compression and reconstruction. It involves the following steps: Acquired image is divided into NxN blocks and 2D DWT is applied to decompose the image; the low frequency coefficients are passed to the next stage and decomposed while the high frequency coefficients are discarded; 8-pt DCT is applied to the DWT component; JPEG quantization is carried out and the quantized image is further scaled. This scheme performs well in noisy environment and reduces the false contouring effect and blocking artifacts. Also for fixed level of distortion, the number of bits required to transmit the hybrid coefficient is less than the other schemes.

Mishra Keerti et al (2013) proposed a technique to achieve higher compression rates by applying different compression thresholds for LL and HH band wavelet coefficients. The DCT is applied to HL and LH band by maintaining the quality of the reconstructed image which is further quantized and unique binary codes for encoding. An algorithm for medical image compression is developed using hybrid DWT and DCT transform techniques, entropy coding and lifting scheme based filter. The following methodology is used in this algorithm: The original RBG image is converted into YC_bC_r image; Forward DWT is applied on the image using Multi resolution technique; Image is divided into horizontal and vertical details into non overlapped 8x8 blocks and Discrete Cosine Transform (DCT) is applied; Adaptive quantization is implemented on the DCT and DWT coefficient bands; Differential Pulse Code Modulation (DPCM) technique is implemented and Huffman coding algorithm is done. It is concluded that this technique is used to obtain higher compression rates. Bharath et al (2013) proposed a hybrid compression technique using DWT, DCT and Huffman techniques to reduce the blocking artifacts and also false contouring that occurs during DCT technique. The steps involved are as follows: the source 256x256 image is divided by splicing into 32x32; 1D – DWT is implemented on the image and is divided into 16x16 blocks; 2D-DWT is implemented on the image and is divided into 8x8 blocks; 2D-DCT technique is applied on the 8x8 image block and is quantized; Huffman coding is performed for better compression. The proposed algorithm has decreased the contouring effects (DCT) in the reconstructed image. Nikita Bansal and Sanjay Kumar Dubey (2013) illustrated a hybrid image compression transform technique. The main aim is to have high compression ratio by maintaining good quality and also to reconstruct the image with less computation resources. The steps involved are: Input image 256 x 256 is divided into 32x 32 using DCT technique; 1st level of 2D-DWT is performed on the 32x32 image to obtain 16x16 blocks; by implementing the 2nd level of 2D-DWT the image is divided into 4x4; scaling is done and at the receiver's end rescaling and inverse of DWT and DCT technique is applied. DCT technique performs effectively at medium rates; using DWT technique produces blurring image at boundaries. By combining the advantages of both techniques, higher compression ratio is achieved.

IV. SPIHT BASED COMPRESSION TECHNIQUES

Prathyusha Reddi et al (2013) proposed a new image compression scheme by combining Hyper analytical Wavelet Transform (HWT) and Set Partitioning in Hierarchical Tree (SPIHT) which resulted in appreciable increase in PSNR and compression ratio. The proposed algorithm comprises of the following steps: Source image is converted into a hyper analytical image by Hilbert Transform; each component of the image is decomposed into wavelet coefficients by 2D DWT method; Encoding is done by using SPIHT technique to achieve desired compression ratio; Reconstruction of the image is obtained by the reverse process. As a result the combination of HWT and SPIHT produces better quality of reconstructed images when compared with the combination of DWT and SPIHT. Salija et al (2013) proposed a technique to achieve high compression ratio by using block based seam carving with hybrid transform and SPIHT algorithm. The stages involved are: The RGB image is input and converted into YC_bC_r format; Image analysis is performed to extract the Region of interest (ROI); manually define the region and sharpen that ROI region by using filter to give contrast to ROI and high weighing factor is given to ROI is to get high energy value; DWT is performed on the carved images; DCT is applied to the wavelet coefficients; SPIHT is used for coding the transformed coefficients; Recovery of image can be done by applying the reverse process. This method is not only efficient for obtaining high compression ratio but also to obtain images with high quality in given bitrate with less complexity. Also it provides good quality and efficient method to avoid duplication of data with less complexity and storage space.

V. IMAGE COMPRESSION USING NEURAL NETWORKS

Sridhar et al (2013) illustrated a wavelet transform and neural network based model for image compression. The demonstrated technique comprises of the following steps: Store a color image of a moderate size; Discrete Wavelet Transform (DWT) is used to decompose the image to obtain approximation coefficients; the coefficient bands are compressed using DPCM and Neural Network techniques; Huffman Coding is performed on the bit stream to obtain the compressed image; Reconstruction is done by the reverse process. This illustrated technique results in improved quality of reconstructed images and eliminates blocking effects associated with DCT. Moreover it can be used in Bar code creation and can also be used in various fields like space, medical, defense and many more.

Abdul Khader Jilani Saudagar and Abdul Sattar Syed (2013) proposed Image compression by transforming the image into another domain with ridgelet function and then quantizing the coefficients. The methodology is as follows: Decompose the input data into a set of wavelets bands into smooth blocks of side length 1; Non redundancy transformation is achieved by the FRIT; In Finite RAdon Transform (FRAT), 2-D wavelet transform is performed; high-pass filter and a low-pass filter are applied to the approximation bands and smooth partitioning is done on each window; FRIT is performed on each window; hybrid neural network with Back propagation algorithm is carried out on the given input; Reconstruction of the image is done by inverse process. It is observed that proposed algorithm is able to achieve good quality performance with a simple algorithm. Also it does not require complicated bit allocation procedures.

Venkata Subbaroa et al (2013) stated that for still digital image or video, a lossy compression is preferred. A combination of Discrete Wavelet Transform (DWT) and Neural Network (NN) techniques are used. The two levels are as follows: In the Single level compression, the image to be compressed is input and the Discrete Wavelet Transform (DCT) is applied and the image is passed to the next level. In the Multiple level compression, the Neural Network (NN) technique is implemented and this compressed image is quantized. Reconstruction of the image with high compression ratio is achieved by performing the inverse of both the techniques. Neutral network based hybrid technique has high compression ratio. Also noise on the compressed data does not affect the original data in neural network.

VI. CONCLUSION

An extensive literature survey on various lossy image compression techniques is performed in this paper. From the survey, the major conclusions are as follows: DCT-DWT and SPIHT provides higher compression ratio and good quality output images. However the performance of these techniques is affected in the presence of noise. Soft computing based compression technique works well in robust environment and provides higher compression ratio and higher PSNR and good quality. Neural Network algorithm results in improved quality of reconstructed images as it eliminates blocking effects associated with DCT. Moreover it can be used in Bar code creation and can also be used in various fields like space, medical, defense and many more applications.

REFERENCES

[1] K. Prasanthi Jasmine, Dr. P. Rajesh Kumar and K. Naga Prakash, An Effective Technique To Compress Images Through Hybrid Wavelet-Ridgelet Transformation, International Journal of Engineering Research and Applications (IJERA) (ISSN: 2248-9622) Vol. 2, Issue4, July-August 2012, pp.1949-1954

[2] Indrit Enesi, Wavelet Image Compression Method Combined With the GPCA, International Journal of Video & Image Processing and Network Security IJVIPNS-IJENS Vol: 12 No: 05 10 (2012)

[3] E. Praveen Kumar and Dr. M. G. Sumithra, Medical Image Compression Using Integer Multi Wavelet Transform for Telemedicine Applications, International Journal Of Engineering And Computer Science (ISSN: 2319-7242) Volume 2 Issue 5 May, 2013 Page No. 1663-1669

[4] Meenakshi Chaudhary and Anupma Dhamija, Compression of Medical Images using Hybrid Wavelet Decomposition Technique, International Journal of Science and Research (IJSR), Volume 2 Issue 6, June 2013

[5] Aree Ali Mohammed and Jamal Ali Hussein, Efficient Hybrid Transform Scheme for Medical Image Compression International Journal of Computer Applications (0975 – 8887) Volume 27– No.7, August 2011.

[6] S.Parveen Banu and Dr.Y.Venkataramani, An Efficient Hybrid Image Compression Scheme based on Correlation of Pixels for Storage and Transmission of Images, International Journal of Computer Applications (0975 – 8887) Volume 18– No.3, March 2011

[7] Bheshaj Kumar, Kavita Thakur and G. R. Sinha, A New Hybrid JPEG Image Compression Scheme Using Symbol Reduction Technique. (2012).

[8] Harjeetpal singh and Sakhi Sharma, Hybrid Image Compression Using DWT, DCT & Huffman Encoding Techniques, International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 10, and October 2012.

[9] Sriram M.B and Thiyagarajan.S, Hybrid Transformation Technique For Image Compression, Journal of Theoretical and Applied Information Technology (ISSN: 1992-8645 Vol. 41 No.2)31st July 2012.

[10] Moh'd Ali Moustafa Alsayyh and Prof. Dr. Dzulkifli Mohamad, Image Compression Using Hybrid Technique, Information and Knowledge Management (ISSN 2224-5758 (Paper) ISSN 2224-896X (Online) Vol 2, No.7) 2012

[11] Manisha Singh and Agam Das Goswami, Image Compression Technique Using Hybrid Discreet Cosine Transform (DCT) and Discreet Wavelet Transform (DWT) Method, International Journal Of Advanced Research In computer Science And Software Engineering (ISSN: 2277 128X Volume 2, Issue 10) October 2012

[12] Er.Ramandeep Kaur Grewal and Navneet Randhawa, Image Compression Using Discrete Cosine Transform & Discrete Wavelet Transform, International Journal of Computing & Business Research (ISSN (Online): 2229-6166), 2012.

[13] Mrs. Mishra Keerti, Mrs.Verma Deepti, Mr. Verma R.L, Hybrid DWT-DCT Coding Techniques for Medical Images, International Journal Of Engineering And Computer Science (ISSN:2319-7242 Volume 2 Issue 4) April, 2013, Page No. 1244-1249

[14] K.N. Bharath, G. Padmajadevi and Kiran, Hybrid Compression Using DWT-DCT and Huffman Encoding Techniques for Biomedical Image and Video Applications, International Journal of Computer Science and Mobile Computing (ISSN 2320–088X Vol. 2, Issue. 5), May 2013, pg.255 – 261

[15] Nikita Bansal and Sanjay Kumar Dubey, Image Compression Using Hybrid Transform Technique, Journal of Global Research in Computer Science, 4 (1), January 2013, 13-17

[16] D. Prathyusha Reddi and M. N. Giri Prasad, A New Image Compression Scheme Using Hyperanalytic Wavelet Transform and SPIHT, Contemporary Engineering Sciences, Vol. 6, 2013, no. 2, 87 – 98 Hikarai LTD

[17] Salija.P, Mrs.Manimekalai M A P and Dr. N A Vasanti, Improved Image Compression Technique Based on Seam Carving and Hybrid Transform, International Journal of Computer Science and Management Research Vol 2 Issue 4 April 2013 (ISSN 2278-733X)

[18] Mr. S. Sridhar M.I.S.T.E, V.Venugopal, S. Ramesh, S.Srinivas and Sk. Mansoob, Wavelets and Neural Networks based Hybrid Image Compression Scheme, International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) Volume 2, Issue 2, March – April 2013 (ISSN 2278-6856)

[19] Abdul Khader Jilani Saudagar and Abdul Sattar Syed, Image compression approach with Ridgelet transformation using modified Neuro modeling for Biomedical Images, © Springer-Verlag London 2013.

[20] M. Venkata Subbarao, N.Sayedu Khasim, Jagadeesh Thati and M. H. H.Satary, Hybrid Image Compression using DWT and Neural Networks, International Journal of Advanced Science and Technology Vol. 53, April, 2013.