"Performance Analysis of Crime Images Using CROI with JPEG & WAVELET"

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***Abstract*--The basic goal of ROI based compression for Crime images is to enhance the compression efficiency for transmission and storage [2]. Sometime Crime images compression addresses the issues of larger storage and faster transmission requirements. Here ROI compression of Crime images aims at compressing the diagnostically important region in forensic lab, region of interest (ROI) of an image with supreme quality as compared to rather unimportant area i.e. the background. Thus, the ROI area is compressed with less compression ratio and the background with the highest possible compression ratio in order to get better overall compression performance.**

As a part of ROI compression technique CROI with JPEG and WAVELET compression algorithms have been implemented using MATLAB. A detailed analysis on the basis of parameters like CR, mean square error (MSE), peak signal to noise ratio (PSNR) and COC has been carried out to evaluate these algorithms. With the use of ROI approach and JPEG algorithm, a PSNR of 34.72 for crime has been achieved with extremely good quality of image area.

***Keywords*:** DCT, JPEG, ROI

I. INTRODUCTION

In conventional compression model, an entire image is compressed equally, i.e. equal or same level of compression is applied to the useful area as well as to the redundant area of an image. But sometimes, in crime image compression in particular it is desired to preserve the quality of a particular portion of an image more as compared to the rest of the image. The disadvantage of a conventional compression system is that it will compress the entire image with same compression ratio. Hence we cannot get a good overall compression performance in case of a conventional compression algorithm. And that is where a newer concept of compression, called the ROI Compression arises where the important and unimportant areas of an image are compressed with different compression ratios.

Now, crime scene images comprise of: Region of Interest (ROI), that used for the diagnosis and unimportant area-Background region, which comprises the less important information and is redundant. The background area in a crime image is quite large and we can compress it with quite a large compression ratio as it contains the redundant information. Again we cannot compress the diagnostically important area (ROI) beyond certain CR, in order to retain quality of the reconstructed image. Hence, the Contextual compression aims at compressing the ROI with the best quality (and least CR) and compressing the background with poor quality (and highest CR) to attain an overall better compression performance.

The evolution of performance is based on the following parameters [4].

A. Correlation coefficient

$$CoC = \frac{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\,\hat{f}(x,y)}{\sqrt{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)^2}\sqrt{\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} \hat{f}(x,y)^2}}$$

It suggests how closely the reconstructed image is correlated with an original image, on a scale of 0-1. The nearer the value of CoC to 1 the higher the correlation of a compressed image to an Original image is there and vice versa.

B. Mean Square Error

$$MSE = \frac{1}{NM}\sum_{x=0}^{N-1}\sum_{y=0}^{M-1}\left[\left|f(x,y)-\hat{f}(x,y)\right|^2\right]$$

Where, $f(x,y)$ is the original pixel value and $\hat{f}(x,y)$ is the compressed pixel value, for an N×M input image.

C. Peak Signal to Noise Ratio

$$PSNR = 10\log\left[\frac{(255)^2}{MSE}\right]$$

Peak signal-to-noise ratio, the ratio between the maximum possible power of a signal and the power of corrupting noise. Higher PSNR would normally indicate that the reconstruction is of higher quality noise is the error introduced by compression.

D. Compression Ratio

CR= (size of original image in bits)/(size of compressed image in bits)

II. THE ROI CODING SCHEMES

Using conventional compression methods could hardly achieve the CR of 40 percent for crime images and that too with much degradation and poor visibility of compressed image. But with contextual compression scheme CR of even 65 percent are quite achievable with superior quality and extremely little degradation of ROI. Some of the ROI coding methods are available each and every methods have Advantages and Disadvantages[2] here we have analyzed results of various methods and then we have proposed new ROI algorithm combined with jpeg algorithm.

A. General Scaling Based Method

This method allows the general scaling based method place ROI associated bits in the higher bit planes by scaling the bit planes of ROI coefficients up, so that ROI coefficients can be coded firstly in the embedded bit plane coding. This method allows the use of arbitrary scaling value and allows fine control on the relative importance between ROI and BG. First, it needs to encode and transmit the shape information of the ROI. This rapidly increases the algorithm complexity. Second, if arbitrary ROI sharps are desired, the shape coding will consume a large number of bits, which significantly decreases the overall coding efficiency.

B. Maxshift Method

The main strength of Maxshift is its fast ROI reconstruction. It also lifts the restriction on ROI shape. The Maxshift method includes the increase in coding time and background is received only after full ROI reconstruction.

C. *Implicit ROI Coding*

The main advantage of the implicit ROI encoding is its low complexity. The method itself is straightforward and easy to implement. More than that, no bit plane scaling is involved at either the encoding or the decoding side and slow ROI reconstruction. This is because the priority arrangement is made on a block-by-block basis and some ROI code blocks may contain a large amount of BG information.

The performance parameters have been discussed in detail by many authors and may be referred in [6]. The output performance parameters have been analyzed quantitatively and plotted which clearly show the superiority of the proposed method at high compression rates in comparison to the methods.

III. IMPLEMENTATION PROCEDURE

A. CROI JPEG [1] Algorithm Steps for Compression of CRIME Images

Step1:-Initialize the image parameters and load the original crime image to be compressed selectively using function like IMREAD.

Step2:-The pre-processing and filtering is performed to rectify the noise if any.

Step3:-Activate the ROI mask to get the selection of ROI. Use ROIPOLY function to select a polygonal region of interest within an image. ROIPOLY returns a Binary image that you can use as a mask for masked filtering. Binary image with 0's outside the region of interest and 1's inside.

Step4:-After the ROI mask is activated, the priority adjustment is done to prioritize the encoding of Contextual region (ROI), so the ROI encoding can be done first and BG encoding later

Step5:-Now selection of the Contextual region i.e. the ROI is done based on the ROI mask.

Step6:-The contextual region (ROI) is separated from the image as per the requirement and set high priority of encoding using IMMULTIPLY.

Step7:-Separate the BG form the image and assign low priority for encoding.

Step8:-Encoding of the ROI region is performed selectively with the JPEG algorithm [1] using DCT [5] and Huffman coding method [1] with low CR.

Step9:-Encoding of the BG is performed with the JPEG Huffman coding technique with a very high CR.

Step10:-Now activate the encoded ROI for merging with BG.

Step11:-Activate the encoded BG for merging with the ROI.

Step12:-Now, merge the BG and the ROI.

Step13:-After merging of the ROI and the BG, get the compressed image encoded.

Step14:-Compressed image may be stored as per the requirement.

Step15:-The reconstruction of the image is done after decoding the compressed image encoded data.

Step16:-After reconstruction, the image is correlated with original one, Decide on the basis of MSE, PSNR and CoC.

B. CROI with Wavelet Algorithm [7] Steps for Compression of CRIME Images

Step1:-Identify the region (ROI) from the test image.

Step2:-Set ROI mask on source image.

Step3:-Generate the ROI Mask using roipoly() function

Step4:-Obtain the corresponding mask in transform domain.

Step5:-Split ROI and the background (BG) from test image f(x,y) using immultiply().

Step6:-Select the compression methodology for ROI and BG respectively.

Step7:-Calculate the wavelet coefficients of ROI & BG separately for priority encoding of the test image f(x,y).

Step8:-Obtain the bit allocation for each ROI and BG regions.

Step9:-Quantize the wavelet coefficients for each sub band of each region (ROI & BG) by the bit allocation resulting from step8, and send the quantized coefficients to entropy encoder progressively

Step10:-Compress the ROI region with very low CR (high bit rate) lossy or near lossless by quantization in step 9.

Step11:-Compress the BG region with very high CR (low bpp) and lossy by quantization in step 9.

Step12:-Multiplex the entropy coded coefficients and CROI mask in order to make bit stream.

Step13:-Get the compressed bit stream of f(x,y) for ROI & BG separately.

Step14:-Decode the image f(x,y) (Decoding process is the inverse order of the encoding process).

Step15:-Merge the ROI and the BG regions to get decoded image. Calculate performance parameters of ROI, BG and Image.

Step16:-Check the Image quality by the HVS and the Correlation. Compare and analyze output compression performance parameters.

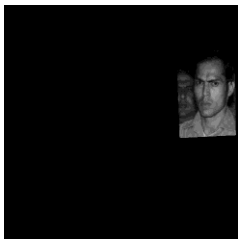
Step17:-Repeat the process by changing bpp till the desired quality and the required compression performance parameters (CPP) are achieved.

Step18:-End the process if satisfactory Image quality metrics parameters and image quality are achieved.

Results of ROI JPEG on Crime Image


Original Image Crime.bmp


Activated ROI mass.bmp


Separated ROI .bmp

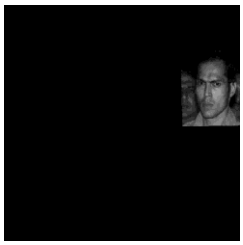

Separated Background.bmp


ROI+BG Compressed result.jpg

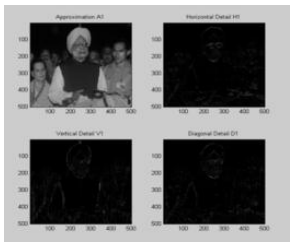
Fig 1

Results of ROI WAVELET on Crime Image


Original Image Crime.bmp


Separated ROI .bmp


Separated Background.bmp


Level 1 Decomposition


ROI+BG Compressed result.jpg

Fig 2

TABLE I : ROI WAVELET AND ROI JPEG PERFORMANCE COMPARISION ON CRIME IMAGE

Sr. No.	CR	BPP	MSE		PSNR		CoC	
			JPEG	WAVELET	JPEG	WAVELET	JPEG	WAVELET
1	20.01	0.40	21.906372	20.021068	34.725099	35.115931	0.9986	0.9987
2	32.02	0.25	39.432816	24.032544	32.172226	34.322806	0.9975	0.9984
3	40.01	0.20	45.789744	29.702916	31.523121	33.402813	0.9971	0.9980
4	44.39	0.18	56.375292	40.474912	30.619916	32.058944	0.9965	0.9972
5	51.07	0.15	68.245972	45.824460	29.790033	31.519830	0.9957	0.9969

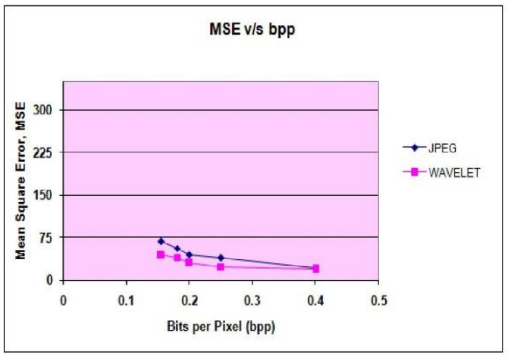


Fig 3 (a)

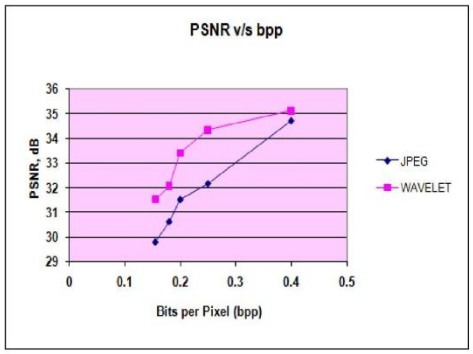


Fig 3 (b)

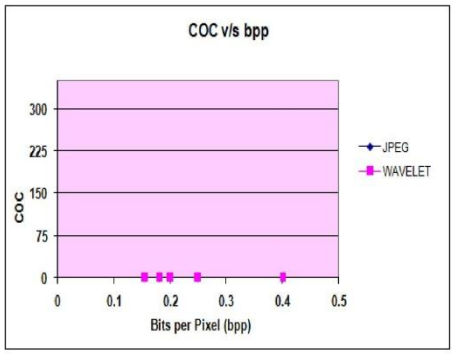


Fig 3 (c)

IV. RESULTS AND DISCUSSION

From TABLE I and Fig 3(b) we can say that Using ROI JPEG we get the PSNR up to 34.72 dB in crime image. From Fig 1 we can see that ROI is compressed with better quality than background for crime image. Also we get the good visual quality of image area (ROI).From TABLE I and Fig 3(b) we can say that Using ROI WAVELET we get the PSNR up to 35.11 dB for region of interest in crime image.

CONCLUSION AND FUTURE WORK

WAVELET with ROI is a powerful tool than JPEG for compressing an image. Here we have used gray scale Crime images and selecting single ROI but it is possible to work with color images and selecting multiple region of interest.

REFERENCES

[1] M. A. Ansari and R. S. Anand, "Performance Analysis of Medical Image Compression Techniques with respect to the quality of compression", Published in IET-UK International Conference on Information and Communication Technology in electrical sciences (ICTES 2007), Dr. M.G.R. University, Chennai, Tamilnadu, India. Dec. 20-22, 2007. pp. 743-750.

[2] M.A. Ansari and R.S. Anand, "Context Based Medical Image Compression with Application to Ultrasound Images" Proceedings of the 20th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, Vol. 20, No 3, 1998.

[3] R. K. Kher, C. K. Modi and R. S. Anand, "Ultrasound Medical Image Compression Using Contextual Approach", International Conference on Recent Advancements and Applications of Computer in Electrical Engineering (RACE 2007) at Engineering College, Bikaner during March 24-25, 2007.

[4] R.C. Gonzalez and R.E. Woods, "Digital Image Processing", Second Edition, Pearson Education.

[5] H. Yang, M. Long and H.-M. Tai, "Region-of-interest image coding based on EBCOT", IEE Proceedings on Visual Image Signal Processing, Vol. 152, No. 5, October 2005.

[6] Xu Yan et al., "The Coding Technique of Image with Multiple ROIs using Standard Maxshift Method", The 30th Annual Conference of the IEEE Industrial Electronics Society, Busan, Korea, pp 2077-2080, 2004.

[7] M.A. Ansari and R.S. Anand, "DWT Based Context Modeling of Medical Image Compression", Department of Electrical Engineering, Indian Institute of Technology Roorkee, Roorkee-247667 INDIA. E-mail: ma.ansari@ieee.org, XXXII NATIONAL SYSTEMS CONFERENCE, NSC 2008, December 17-19, 2008.

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