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A Review on Image Compression Techniques

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Abstract: Fractal image compression (FIC) is very useful in situation, where we have to deal with Chunk of data with limited storage space and low band width. This lossy compression technique gives a high compression ratio by representing the image in a vector form representation. Main drawback of standard image compression techniques of JPEG and JPEG 2000 are resolution dependent and poor PSNR value at high compression ratio. This lossy compression technique provides good trade off between PSNR value and compression ratio. In this survey paper different image compression techniques are compared.

Keywords: Image Compression, wavelet transform, Disctete cosine transform, Fractal.

I. INTRODUCTION

Image compression techniques are used to reduce the number of bits required to represent an image without losing the intelligence in the image. In Compression the property of different redundancy is used to represent image using lesser no of bits compared with the original image. There are mainly two types of image compression techniques, lossy image compression and loss less image compression techniques [1,2].In our present multimedia world ,this technique has a very important role.

In lossless compression, every detail of the original data is reconstructed while decoding. This provides modest amount of compression and reduces file size without loss of quality. This is applicable to image and video files. It reconstruct the information of the original file in an efficient way. But the images and audio files which are compressed using lossless encoding are larger in size because no quality is lost. Lossy image compression techniques provides high compression ratio. So file size of the compressed image is much reduced .Fractal image compression is a lossy compression technique and image is represented in a vector form[3,4,5].Comparing with other image compression techniques this provides a very high compression ratio and this technique is a resolution independent compression technique.

II. DIFFERENT METHODS OF IMAGE COMPRESSION

A. JPEG:

This is a standard image compression method. This method uses Discrete cosine Transform method, which is a frequency domain transformation method.[6]To exploit this method, first image is divided into non-overlapping 8x8 block and each time domain block is transformed into frequency domain block by applying DCT on each block. The frequency coefficients are normalized by different scales with reference to the quantization table provided by the JPEG standard conducted by some psycho visual evidence. The quantized coefficients are rearranged and further compressed by an efficient lossless coding strategy such as run length coding, arithmetic coding, or Huffman coding. The JPEG standard defines a standard 8×8 quantization table for all images which may not be appropriate. To get a better PSNR value an adaptive quantization table is used. The main drawback of this method is the squaring effect in the reconstructed image because of 8x8 partitioning.

B. JPEG 2000

This is another standard image compression technique. This is a Transform domain compression technique [7, 8, 9]. Compression is done in the frequency domain. Discrete Wavelet transform is used to convert the image from time domain to frequency domain. These Wavelets are functions defined over a finite interval and having an average value of zero.

The basic idea of the wavelet transform is to represent any arbitrary function as a superposition of a set of such wavelets or basis functions. These basis functions are obtained from a single prototype wavelet called the mother wavelet, by dilations or contractions (scaling) and translations (shifts).

The Discrete Wavelet Transform of a finite length signal x(n) having N components, for example, is expressed by an N x N matrix Despite all the advantages of JPEG compression schemes based on DCT namely simplicity, satisfactory performance, and availability of special purpose hardware for implementation; these are not without their shortcomings. Since the input image needs to be blocked, correlation across the block boundaries is not eliminated. This results in noticeable and annoying ``blocking artifacts" particularly at low bitrates

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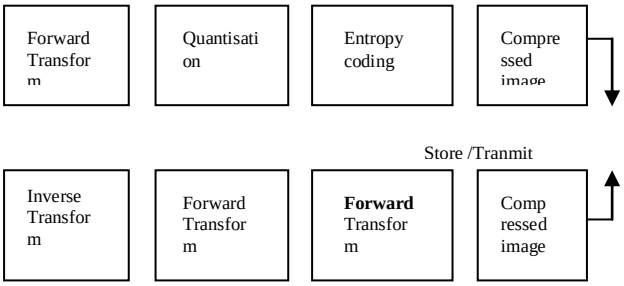

Figure1: Encoding and Decoding Block diagram of JPEG 2000

C. VQ Compression:

Vector quantization technique allows the mathematical modeling of probability density function by distribution of proto type vectors [10]. This compression technique is a method of encoding values from a multidimensional non-overlapping mage blocks. The closest code word for a vector space into a finite set of values from a discrete subspace of lower dimension. Data is represented in a lower space .In the encoding side image is divided into a set of given block is the one that has minimum Euclidean distance from the input block

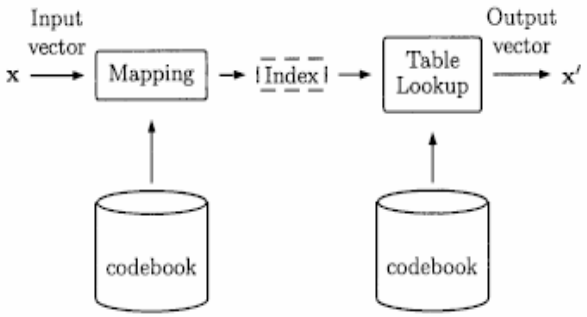

Figure2: Block diagram of VQ

VQ always achieves better performance than transform coding under the same bit rate. No other coding technique, which operates on a vector of signal samples, exists that can do better than Vector quantization. This is a Lossy compression technique

D. Basic Fractal Compression:

An image which shows self similarity at different level of scales is named as fractal image [5].

Figure3: Fractal images

We can see that all natural images and textured images exhibit self similarity at different level of scales. Image of fire and image of celestial bodies shown in figure3 are examples of fractal images.

So Fractal image compression is suitable for Natural and textured images. This vector form of image representation is a lossy compression technique. This method utilizes the self similarity property in a image. In Basic Fractal Image Compression Parts of the image is represented as the linear transformation of the full image. But in Partitioned Fractal Image Compression Lower entropy Rage blocks in the image is represented as the Dihedral transformation of the higher entropy domain blocks. Textures and natural images, relying on the fact that parts of an image often resemble other parts of the same image .Fractal image compression is based on the mathematical principle of Collage Theorem .Image is represented as a collection of affine transformations ,which is known as Iterative Function System(IFS)

$$w_i \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} a_i & b_i \\ c_i & d_i \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} e_i \\ f_i \end{bmatrix}$$

Figure 4: Matrix representation of affine transformation.

The coefficients of affine transformation are adjusted in order to shrink, translate, rotate, and shear the new image, so that it lies over a part of input image. Parameters a,b,c and d represent the linear transformation operation on the domain block to get the best approximation of the chosen range block and e and f are the coordinates of the domain block, which shows best correlation with the chosen range block. Here z denote the intensity of the pixel in the location x and y, s and o are the contrast and brightness adjustments for the transformations. The set { w} is called the affine transformations.

E. Wavelet –Fractal Image Compression

The Discrete wavelet transform (DWT), that uses the method of sub band coding, is found to afford a fast computation of wavelet coefficients This technique is easy to implement and also reduces the no of computation period and necessary resources. The basis function is the wavelet transform, which are related to each other by simple scaling and translation operations.

The signals to be analysed are passed through low pass and high pass filters with different cut off frequency at different scales. When a signal passes through a filter its splits into 2 bands, lower and higher frequency sub bands where these procedures are repeated for only the low frequency sub bands to obtain a multilevel wavelet decomposition of an image [11].Wavelet-Fractal image compression utilises the multi resolution property of

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Wavelet transform and self similarity property of fractal compression technique. This hybrid technique reduces the no of mean square computation so that encoding time can be highly reduced compared with the technique of Basic Fractal Image Compression .Here each sub band image is compressed by using fractal algorithm. During decoding fractal codes are iteratively applied to each sub-band of the arbitrary image.

III. COMPARISON OF VARIOUS COMPRESSION METHODS

Algorithm	PSNR	Encoding Time	Decoding Time
JPEG	31.65	0.13	0.12
JPEG2000	34.88	0.45	0.27
VQ	29.28	1.46	0.18
FIC	29.04	6.65hrs	0.88
WFC	22.23	1.05hrs	0.78

Method	Advantages	Disadvantages
JPEG	Current Standard	Coefficient(dct) quantization Bit allocation
JPEG 2000	High Compression Ratio State-Of-The-Art	Coefficient quantization Bit allocation
VQ	Simple decoder No-coefficient quantization	Slow codebook generation Small bpp
BFIC	Good mathematical Encoding-frame	Slow Encoding Image
WFC	Encoding is faster than BFIC	PSNR value is reduced slightly than BFIC

(a) (b) (c)

(d) (e) (f)

Figure 5: (a) Original image(b) out image of JPEG 2000(c) out image of JPEG(d) out image of VQ)(e) out image of BFIC(f) out image of WFC

IV. CONCLUSION

This paper represents method of different image compression techniques. The Parameters, PSNR, Encoding time and decoding time of JPEG, JPEG2000, Vector Quantization, Basic Fractal Compression and Wavelet-Fractal Image Compression are compared. JPEG and JPEG 2000 is the commonly used image compression standard. But these techniques are not suitable in situation where we have to transmit and save large size of data. In such situation fractal image compression is the suitable technique but the drawback of Basic fractal image compression is the complexity of encoding phase .Encoding time can be reduced using the hybrid technique of wave let fractal image compression. But the PSNR is reduced in this hybrid method compared with Basic Fractal Image Compression Technique.

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