Incorporation of DCT and MSVQ to Enhance Image Compression Ratio of an image

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***Abstract* – *Image compression plays a vital role in research areas of image processing. The main objective of image compression is to reduce the image size, which leads to fast transferring of images. It is achieved by removing noisy and irrelevant data in the image. In this paper we propose Discrete Cosine Transform (DCT) and Multistage Vector Quantization (MSVQ) scheme to increase image compression ratio. DCT divides image into two frequencies where irrelevant frequencies are removed with the help of quantization and relevant frequencies are used while retrieving an image. Quantization is achieved by compressing a range of values into a single quantum. This is a hybrid method which uses vector quantization at each stage and Differential Pulse Code Modulator (DPCM). DPCM pre process the image after that cosine transformation applied on image. Compared to existing VQ and DCT our proposed DCT-MSVQ increases compression ratio (CR) and reduce storage size of images.*

Keywords –Discrete Cosine Transform (DCT), Multistage Vector Quantization (MSVQ), CR

1. Introduction

Image compression is a technique used to compress an image without losing image data and quality. The main objective of image compression is to reduce the image size, which leads to fast transferring of images. With the use of digital cameras, requirements for storage, manipulation, and transfer of digital images, has grown explosively. There are two types of image compression [7]. One is lossy image compression which reduces image irrelevant information and lossless image compression which does not eliminate any image information and quality.

The most used and successful image-encoding standard should be joint photographic experts group (JPEG) standard [2]. A common characteristic of most images is that the neighbouring pixels are highly correlated and therefore contain highly redundant information. The basic objective of image compression is to find an image representation in which pixels are less correlated. The two fundamental principles used in image compression are redundancy and irrelevancy. Redundancy removes redundancies from the signal source and irrelevancy omits pixel values which are not noticeable by human eye. JPEG and JPEG 2000 [7] are two older techniques used for image compression. There are three types of redundancies, spatial redundancy, spectral redundancy and temporal redundancy. Spatial redundancy is due to correlation among neighbouring pixels. Spectral redundancy is due to different colour planes. Temporal redundancy is due to correlation of different frames of an image. Image compression aims to reduce the number of bits required to represent an image by removing the spatial and spectral redundancies of an image.

2. Related work

DCT is an orthogonal transform method defined by N.Ahmed [9].DCT use cosine functions and it transforms any signal from spatial domain to frequency domain. It mainly focused on set of similar coefficients of an image. After this these coefficients are normalized by quantizer. Next normalized values are encoded by encoder.

Transformer: The main function of transformer is to transform the input images into a format without inter pixel redundancies. Transform coding techniques use a reversible, linear mathematical transform to map the pixel values into a set of coefficients, which are then quantized and encoded. The need of transformer is that to reduce high magnitudes of an image.

Quantizer: Quantization plays a vital role in lossy image encoding. It partitions the input image into a smaller set of values. There are two types of quantization. One is scalar quantization partitions the set of input values into smaller no of intervals and vector quantization extends the scalar quantization values to multiple dimensions. It reduces the psycho visual redundancies of an image.

Entropy:

It builds a fixed or variable length code to represent the quantizer's output and maps the output according to code. Entropy compresses the compressed values obtained by the quantizer to provide more efficient compression. Most important types of entropy encoders used in lossy image compression techniques are arithmetic encoder, and Huffman encoder.

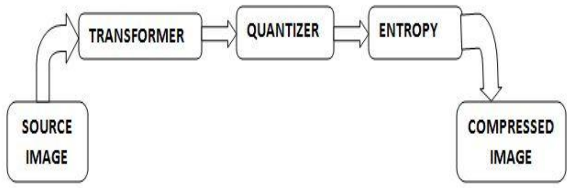

Fig 1.Basic encoding system

Vector quantizers are two types tree structured and classified vector quantizer[3].VQ performed on frequency domain[5]. With the effect of codebook and much iteration so many techniques are proposed to improve LBG algorithm. In the next section we will discuss about MSVQ with improved LBG algorithm.

3. DCT-MSVQ Frame work

MSVQ reduces codebook size, computing time of VQ and quantization errors. There are several steps in MSVQ [6]. First simple quantization performed on given input vector V and it results from codebook B_1 as index i_1 and an error vector t1=V-A1 [1]. Next second stage quantizer takes input which was resulted by first vector. Fig 2 illustrates the MSVQ.

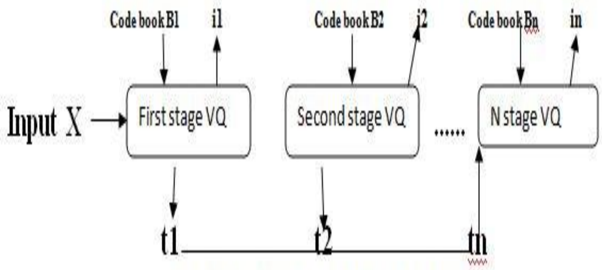

Fig 2.Multistage Vector Quantization System

Steps involved in PNN algorithm for improvements in LBG [10].

- Divide image into y*y blocks and apply DCT to each block.
- Select the DCT coefficients which are arranged in zigzag order.
- Divide the vector into Dc coefficients and k-1 dimension vector v.
- Perform SQ and DPCM to DC coefficients.
- Initialise error vector.
- Make codebook Bn by using error vector tn.
- Perform VQ.
- If VQ reaches N then goto next step.
- Export code book index tables.
- Do entropy process.

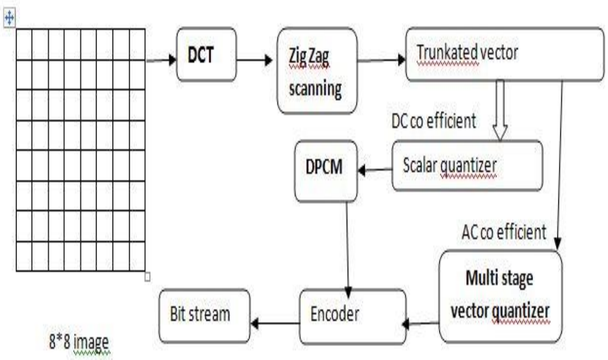

Fig .3 MSVQ encoding process

Fig 3 explains about our proposed encoding process.

4. Result Analysis

In this section we show the results of DCT-MSVQ algorithm. It not only compresses the image but also reduces the storage space. It first divides the image into 8*8 blocks, and DCT [8] is applied. First few frequencies are selected as vector, each vector divided into AC and DC co-efficient. DPCM performed on DC coefficients, and VQ is performed on AC coefficients. After that LBG+PNN algorithm [9][10] is applied, and then Huffman encoding is performed to get DPCM code. Peak Signal to noise ratio (PSNR) is used to measure the quality of image.

$$PSNR = 10\log_{10}\left[\frac{255^2}{\frac{1}{MN}\sum_{i=1}^{M}\sum_{j=1}^{N}\left[I_{in}(i,j)-I_{out}(i,j)\right]^2}\right](dB)$$

The proposed algorithm (DCT+MSVQ) gives enhanced results as compared to DCT-VQ [4].

Sample Images	DCT+VQ	DCT+MSVQ
Img1	33.57	33.90
Img2	30.86	31.72
Img3	31.80	32.20

Table 1: Comparison of PSNR of DCT-VQ. DCT-MSVQ

Fig 4. a) Original image b) DCT-MSVQ c) DCT-VQ

5. Conclusion

In this paper we implemented DCT-MSVQ a new frame work for image compression. It increases image sending speed. Differential Pulse Code Modulator (DPCM) helps in pre-processing of image. This paper mainly focused on fast and efficient lossy mechanisms to increase compression ratio. Compared to existing VQ and DCT our proposed DCT-MSVQ increases compression ratio (CR) and reduce storage size of images. For further enhancements, focused on DCT-MSVQ with improved CR and aims to improve quality of image.

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