Effective Image Compression Using Block Truncation Technique

Priya V.[1] Dr.A.R.Mohamed Shanavas[2]
[1]Jamal Mohamed College,Trichy

Abstract— Block truncation coding (BTC) is a simple and fast lossy compression technique for digitized gray scale images. The key idea of BTC is to perform moment preserving (MP) quantization for blocks of pixels so that the quality of the image will remain acceptable and at the same time the demand for the storage space will decrease. It is a simple and fast algorithm which achieves constant bit rate of 2.0 bits per pixel. The method is suboptimal and divides the original images into small sub-images using a quantizer, taking more size and processing time. The aim is to adapt the sub images to reduce the number of gray. In block truncation coding an image is firstly segmented into n x n blocks of pixels. In the most cases the size is 4 x 4, but other sizes as 8 x 8 can also be used. Secondly, a two level output is chosen for every block and bitmap is also encoded using 1 bit for every pixel. This directly reduces the dimension without any resolution change.

Key words: Block Truncation, Image Processing, Image Compression.

I. INTRODUCTION

Image data compression is concerned with minimization of the number of information carrying units used to represent an image. It known that raw digital image occupy a large amount of memory, the amount of memory required creates problems in massive digital image storage for image archiving in a variety of applications. The image compression techniques are categorized into two main classifications namely lossy compression techniques and Lossless compression techniques.

With the continuing growth of modern communication technology, demand for image transmission and storage is increasing rapidly with advancements in computer technology for mass storage and digital processing has paved the way for implementing advanced data compression techniques. This is done to improve the efficiency of transmission and storage of images. Applications of data compression are primarily required for transmission and storage in case of images. Typically, a compressed image when decoded to reconstruct its original form will be accompanied by some noise or mild distortion. The efficiency of a compression algorithm is measured by its data compression ability, the resulting distortion and as well by its implementation complexity, but least importance is attached to image quality.

II. LOSSY DATA COMPRESSION

Lossy data compression is named for what it does. Whenever lossy data compression is applied to a message, the message can never be recovered exactly as it was before when compressed. When the compressed message is decoded it does not give back the original message exactly. As lossy compression cannot be decoded to yield the exact original message, it is not a good method of compression for critical data, such as textual data. It is mostly used for Digitally Sampled Analog Data (DSAD) which is sound, video, graphics, or picture files.

III. LOSLESS DATA COMPRESSION

In Lossless data compression the original message can be exactly decoded. This method works by finding repeated patterns in a message and encoding those patterns in an efficient manner. For this reason, lossless data compression is also referred to as redundancy reduction. Because redundancy reduction is dependent on the patterns in the message; it does not work well on random messages. Hence Lossless data compression is ideal for text.

IV. BLOCK TRUNCATION CODING

Most image data compression techniques achieve high data compression ratio. The tradeoff between data compression and high quality image remains one of the difficult and persistent problems. Maintaining high compression ratios with good image quality is possible but only at high computational cost. One of the major problems for image data compression is to reduce redundancy in the image block a much as possible. That is, it is very important to represent an image with as few bits as possible while maintaining good image quality. Both compression and decompression algorithms should be simple and efficient.

Block Truncation Coding is an easy to implement image compression algorithms.

The modified version of BTC coding algorithm called interpolative block truncation coding is mentioned below.

In BTC an image is segmented into n×n (typically,4×4) non –over lapping blocks of pixels, and a two-level (one-bit) quantize is independently designed for each block. Both the quantize threshold and the two reconstruction levels are varied in response to the local statistics of a block.

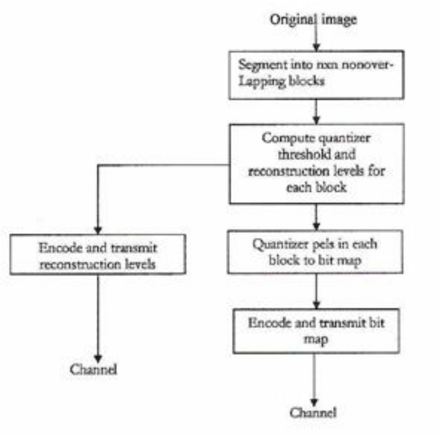

Fig. 1: Block Truncation Coding

V. BLOCK TRUNCATION CODING

In this technique image compression is done using absolute moment block truncation coding. It is an improved version of BTC, preserves absolute moments rather than standard moments, here also a digitized image is divided into blocks of n x n pixels. Each block is quantized in such a way that each resulting block has the same sample mean and the same sample first absolute central moment of each original block.

In block truncation coding, consider the following 4×4 block

$$X = \begin{bmatrix} 146 & 149 & 152 & 156 \\ 97 & 122 & 144 & 147 \\ 89 & 90 & 135 & 145 \\ 85 & 92 & 99 & 120 \end{bmatrix}$$

For this block of pixels, X = 123.0, and q=8 using. The threshold of the bit map is:

$$B = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

Computing the mean of each segment and rounding to the nearest integer, we find that the two reconstruction values are a=99 and b=147. These values are transmitted along with the bit map, and the reconstructed block is

$$X = \begin{bmatrix} 147 & 147 & 147 & 147 \\ 99 & 99 & 147 & 147 \\ 99 & 99 & 147 & 147 \\ 99 & 99 & 99 & 99 \end{bmatrix}$$

If we assume that the reconstruction levels are represented by 8 bits each and no additional source coding is used on the bit map, the total bit rate is (8+8+16)/16=2.0

Bits / pixel.

VI. INTERPOLATIVE BTC IMAGE CODING

In interpolative BTC filled circles denoted pixels, and unfilled circles denote the reconstructed pixels. In this section, represent an interpolative BTC coding algorithm based on sub sampling the truncated bit plane. As the size of bit planes will be reduced by sub sampling, the bit rate compression achieved in this way is significant. It will be demonstrated that, this coding schemes lead to small performance degradation. In the interpolate BTC coding scheme only 8 of the pixels and each block will be coded using BTC as described in previous section. The coded pixels are first decoded. The missing pixels are then reconstructed by interpolation utilizing the four surrounding pixels, which form a cross as shown. This shows that when the interpolation is carried out in the pixel on a multilevel domain; the pixels of adjacent blocks will also be simultaneously used to reconstruct the missing border pixels of a specific block. Thus, there is no need to distinguish one block from the other block during the interpolation and reduces time.

While many interpolators may be used, here median filters are used to perform the interpolation. For interpolative BTC a five point cross-window median filter is used as shown below.

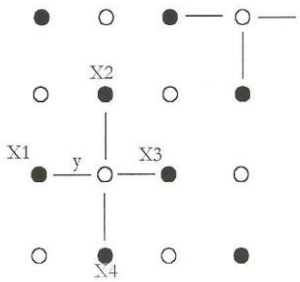

Fig. 2: Diagram of Block Truncative Coding

The advantage of using the median filter as interpolators lies in its ease of implementation and its ability to give good results around sharp edges. In interpolative BTC, only 8 bits of each 4×4 bit plane are transmitted. By assumption that 16 bits are used to code the upper and lower means (8 bits for each), it is easy to see that the resulting bit rate is 1.5 for interpolative BTC. This reduces nearly 25% in bit rate, compared to the standard BTC method described earlier.

VII. CONCLUSION

The spatial domain technique for image data compression, namely, the block truncation coding (BTC) has been considered. This technique is based on dividing the image into (4×4) non overlapping blocks and uses a two-level quantize. The BTC technique has been applied to different grey level test image each contains 64×64 pixels with 8 bits/pixel (256 grey levels). The reconstructed images obtained from applying this technique have a bit rate of 2 bit/pixel, which corresponds to 75% compression. The peak signal-to-noise ratio of the reconstructed image quality comparison of the original and reconstructed image shows that this method provides a good compression without seriously degrading the reconstructed image. A modified BTC coding technique is investigated. This technique is the interpolative block truncation coding (IBTC) and modifies IBTC. The IBTC and MIBTC algorithm is based on sub sampling. The coded pixels are first decoded and then used to reconstruct the missing pixels using median filters interpolators, which makes the interpolation process very simple. The IBTC when applied to the same test images results in a bit rate of the reconstructed image with 1.5 bits/pixel, without a noticeable serious degradation compared with the BTC results. But in the MIBTC the calculation and quality are less than IBTC.

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