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LCD Overdrive Frame Memory Compression Using Adaptive Block Truncation Coding

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ABSTRACT

In order to reduce the frame memory usage in LCD overdrive, there is a basic technique called block truncation coding (BTC) is commonly used due to its efficient coding and low implementation cost. However, there is some limitation of BTC that causes severe perceptual artifacts and degrades overdrive performance. To overcome the problem of BTC here we propose an adaptive multi-level BTC (AM-BTC) in this paper. The AM-BTC as suggested firstly overcomes the limitation by adaptive selection of 2-level or 4-level BTC according to the edge property of the coding block. Then, to reduce the bit rate of AM-BTC we improve the 2-level and 4-level BTCs by using only luminance bitmap to represent three color bitmaps, depending upon the color bitmaps advancement can be done. Moreover, as a result of this paper different types of images are compared for different PSNR values.

Keywords: BTC, Overdrive, AM-BTC.

1. INTRODUCTION

As industrial and consumer demand for high visual quality increases according to that the overdrive technique is becoming a popular method of shortening liquid crystal response time and minimizing the motion blur found in liquid crystal display (LCD) [1]-[3]. To force the liquid crystal material to react faster, overdrive detects and then enlarges the temporal change of the pixel value between current and previous frames. In an ideal overdrive, which was developed by Oura et al. [4] to detect the temporal change, a full frame memory is needed to store and output of the previous frame. With increasing numbers of pixels displayed on today's large liquid crystal panels, the amount of image data stored in the frame memory is escalating. As a result, the ideal overdrive suffers when faced with increasing frame memory size and data transfer rate [3]. It is, therefore, necessary to compress image data stored in the frame memory of LCD overdrive. In the remainder of this paper, an overdrive using compression to reduce the image data, hereafter referred to as overdrive as shown in Fig.1

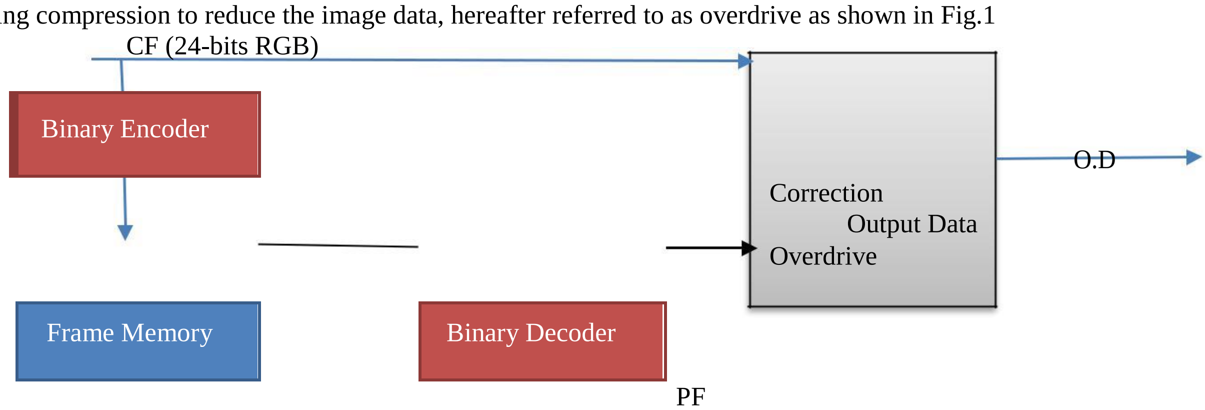

Fig.1 Basic block Diagram of LCD Overdrive

The amount of images data grows day by day. Large storage and bandwidth are needed to store and transmit the images, which is quite costly. Hence methods to compression of the image data are essential now-a-days. The image compression techniques are basically categorized into two different classifications namely Lossy compression techniques and Lossless compression techniques. Lossless compression ratio gives good quality of compressed images but yields only less compression, on the other hand, the lossy compression techniques lead to loss of data with higher compression ratio. JPEG [5] and Block Truncation Coding [7] is a lossy image compression techniques.It is a simple technique which involves less computational complexity. BTC is a recent technique used for compression of monochrome image data and it is one-bit adaptive moment-preserving quantizer that preserves certain statistical moments of small blocks of the input image in the quantized output. The original algorithm of BTC preserves the standard mean and the standard deviation [9]. The statistical overheads Mean and the Standard deviation is coded as part of the block. The truncated block of the BTC is the one-bit output of quantizer for every pixel in the block

.Different methods have been proposed during last twenty years for image compression such BTC and Absolute Moment Block Truncation Coding AMBTC.AMBTC have the higher mean and the lower mean of the blocks that use this quantity to quantize output. AMBTC provides better image quality than image compression using BTC. Block Truncation Coding, or BTC, is a type of lossy image compression technique for gray scale images. It divides the original images into blocks and then uses a quantizer to reduce the number of gray levels in each block while maintaining the same mean and standard deviation. It is an early predecessor of the popular hardware DXTC technique, although BTC compression method was first adapted to color long before DXTC using a very similar approach called Color Cell Compression. BTC has also been adapted to video compression.

2. PROBLEM STATEMENT

Although substantial improvements have been made, the methods based on DCT or DWT still cannot be directly employed in industry applications due to its high computational complexity. The methods have been based on BTC, which are essentially two-level quantization, suffer from their inherent limitation and degrade the reconstructed image hence effect overdrive performance. To solve the limitation, this paper makes up the limitation of the two-level quantization and presents an adaptive multi-level BTC (AM-BTC) for frame memory reduction in LCD overdrive. The AM-BTC uses an adaptive selector based on SAD (Sum of Absolute Difference) to achieve optimal coding performance.

In order to reduce the amount of bit rate, we improve the two-level and four-level BTCs used in AM-BTC by utilizing only luminance bitmap to represent the three color bitmaps. In signal processing, data compression, PSNR , or compression ratios reduction involves encoding information using fewer bits than the original representation given. The compression can be lossless or lossy. Lossless compression reduces bits by identifying and eliminating statistical redundancy and no information is lost in lossless compression. Lossy compression reduces bits by removing unnecessary or less important information. The process of reducing the size of the data file is referred as data compression. In the context of data transmission, it is called source coding (encoding is done at the source of the data before it is stored or transmitted) in opposition to channel coding.

- In early ages, there were different another compression method, which was very difficult to deploy and required a large setup to implement.

- It is the basic requirement of any compression method to maintain the compression ratio of the image as it leads to the blurred images Cost is the important factor as requiring large setup increase out the cost.

- Bit allocation plays an important role in compression as deciding of the number of bits is a challenging task. A Large amount of memory required for storing data of the previous frame.

3. BASIC ALGORITHM

3.1 BLOCK TRUNCATION CODING

As BTC is an easy and efficient technique for the compression of the image as it works on a simple calculation of mean and moments. As there is the basic role of the pixel, which is the smallest quantity of measuring or defining any image. In BTC an image is segmented into n×n (typically,4×4) on –overlapping blocks of pixels, and a two-level (one-bit) quantize is independently designed for each block. Both the quantizing threshold and the two reconstruction levels are varied in response to the local statistics of a block.
The level of each block is chosen such that the first two sample moments are preserved. Let m = n×n, and let X1, X2,

X3…....Xm be the pixel value in a given block of the original image. The quantity we wish to preserve are the first and second sample moments:

 Step 1: Divide the image into small non-overlapping blocks of size 4 x 4 pixels.

 Step 2: Compute the statistical moments x and σ of the block.

$$\_ \quad \bar{} \sum \qquad (1)$$

$$\sigma=\sqrt{\bar{}} \sum \quad \_ \qquad (2)$$

Where xi represents the ith pixel value of the image block and n is the total number of pixels in that block. *x* and σ are termed as quantizers of BTC. Taking *x* as the threshold value a two-level.

 Step 3: The two values
Bitplane is obtained by comparing each pixel value of xi with the threshold. A binary block, denoted by B, is also used to represent the pixels. We can use "1" to represent a pixel whose gray level is greater than or equal to *x* and
"0" to represent a pixel whose gray level is less than

$$B=\{ \qquad (3)$$

 Step 4: Transmit or store the bit-The plane, *x and* σ.

 Step 5: Repeat the steps 2 through 4 for all the blocks of the input image.

3.2 AM-BTC(ADAPTIVE MULTI-LEVEL BLOCK TRUNCATION CODING)

By using the BTC we do not get the output of different color images as we require to maintain the same amount of compression ratio and with different PSNR. The conventional 4×4 block of 4-level BTC and 2-level BTC give the bit rates of 9 bpp and 6 bpp, respectively. In order to apply a codec to LCD overdrive in full HD TV or HD TV, the bit rate should be fixed to 4 bpp, and the line buffer memory should be minimized.

Lema and Mitchell [8] presented a simple and fast variant of BTC, named Absolute Moment BTC (AMBTC) that preserves the higher mean and lower mean of a block [9]. The AMBTC algorithm involves the following steps:

 Step 1: An image is divided into non-overlapping blocks. The size of a block could be (4 x 4) or (8 x 8), etc.

 Step 2: Calculate the average gray level of the block (4x4):

 Step 3: Pixels in the image block are then classified into two ranges of values. The upper range is those gray levels which are greater than the block average gray level (x) and the remaining brought into the lower range.

$$\bar{} \sum \qquad (4)$$

$$\sum \qquad (5)$$

Here k is the number of pixels whose gray level is greater than $\bar{x}$.
Whose gray level is greater than or equal to *x* and "0" to represent a pixel whose gray level is less than $\bar{x}$. The Encoder

Step 4: Binary block, denoted by B, is also used to represent the pixels. We can use "1" to represent a pixel

Writes XH, XL. Then the total number of bits required for a block is 8+8+16=32 bits. Thus, the bit rate for the AMBAC algorithm is 2 bpp.

B={ (6)

- Step 5: By calculating the highest and the lowest values of the 2-level and the 4-level we get the values of AM-BTC

3.3 AM-BTC (4-LEVEL)

It can be done by further quantization of 2-level images with the help of AQC (Adaptive Quantization Compression)

4. Experimental Approach

As the above process defined with the help of different formulas for getting output, we have given out the PSNR comparison of three type of images gray scale, color (2-level), color (4-level).All the simulation and retrieving of the image and performing different types of operation in the image has been done with help of MATLAB while taking a basic image for all of three.

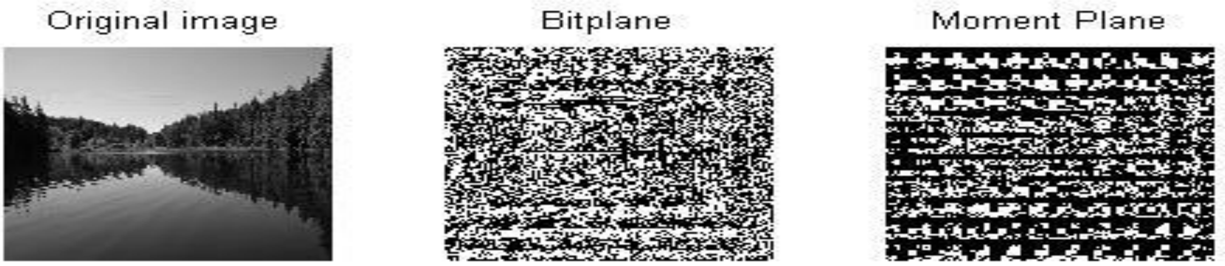

Fig.2 A basic gray scale image has been compressed out with a finite amount of PSNR of 36.087

Fig.3 A color image(2-level) it is first converted to the YCbCr plane then making out its bitmap and the moment plane it is having a PSNR of 21.24

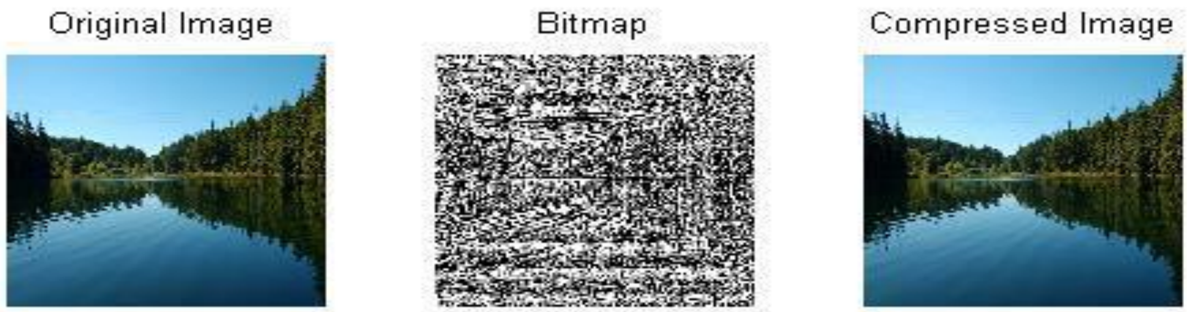

Fig.4 It is the color image (4-level) which is having the best output as required with a PSNR of 40.1813

4. CONCLUSION

As proposed the basic BTC is no doubt an easy way of compressing the image but it lags sometimes when the image pattern been changed, so the new technique of compression i.e ADBTC(Adaptive Block Truncation Coding) come into use. ADBTC is faster than the normal BTC, it also gives out the result with high PSNR and also maintaining the compression ratio of the image. The compression is applied to different images to get out different output. There are various places where this technique has been applying and it gives out good results.

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