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Enhanced Technique for Images to Control Visually Lossless JPEG2000

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Abstract - *One method to compress a pair of stereo images is to compress the first image independently and then compress the second image by estimating the disparity between the two images. The first image was transformed using 2-D Discrete Cosine Transform, quantized using the JPEG quantization matrix and finally encoded into a bitstream using arithmetic encoding. The disparity between the two images was estimated by the Exhaustive Block Matching Algorithm (EBMA) and the resulting disparity vector was then encoded into a bitstream. The images were then decoded and were compared with the original images.*

Key Words: *stereo imaging, stereoscopy, stereo image compression*

1. INTRODUCTION

A pair of stereo images is very similar to each other as they are the images of a stationary object taken from two different angles. This is why compressing both images independently is an in-efficient way of compressing stereo images. An efficient way to compress a pair of stereoscopic images is to calculate the difference between the two images; also known as disparity estimation and then compress one image independently. This image is known as the reference image and can be either the right image or the left image. The reference image and the disparity vectors are then used to reconstruct the second image. A stereo image is produced by taking two cameras, separated by a distance of 6.5 centimeters (which is approximately the distance between the human eyes) and recording the perspectives of the right eye and the left eye using different lenses [2]. The left image is seen through the left lens and the right image is seen through the right lens. The brain then merges the two images into one and also perceives the depth of the object. Stereo images can be produced cheaply using inexpensive digital cameras and are used widely in clinical applications, mining, metallurgy, environmental science and entertainment [1]. In this paper, the left image is taken as the reference image and the disparityvectors between the two imagesare estimated using the Exhaustive Block Matching Algorithm (EBMA). The reference image is transformed using two-dimensional discrete cosine transform (DCT-II) and quantized using the JPEG quantization matrix. The resulting matrix is compressed into a bitstream using arithmetic coding.

2. STEREOSCOPIC IMAGE ENCODER

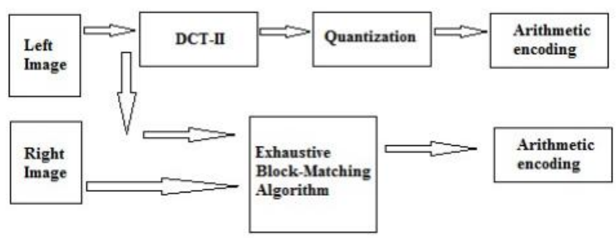

Figure 1: Compressing a Pair of Stereo Images

- The left image is taken as the reference image and is transformed using two dimensional
- Forward discrete cosine transform (DCT-II). The resulting image matrix is quantized using the
- JPEG quantization matrix in (3) and then compressed using Arithmetic coding.
- The second part of the encoder involves compressing the right image. Since the two

- images are very similar to each other, disparity vectors between the two images are estimated.
- The resulting disparity vectors are compressed into a bitstream using arithmetic encoding as described in 2.3.

Transform coding is a component of image processing and is very effective in the compression of still images [5]. Transformation is mainly used to remove the duplicate information between the neighboring pixels in the image. It depends on the assumption that a

pixel in an image is correlated to its neighbor, and this correlation is used to predict the value of the neighboring pixel.The 2-D Discrete Cosine Transform (DCT) was used to perform the transformation because of its strong “energy compaction” [6] property. The steps to perform transformation are –

Step 1 – To perform DCT-II, the first step is to ensure that the pixels are centered around zero. Since the value of a pixel is in the range [0, 255], it can be centered around zero by extracting the value of each pixel and subtracting from it 128.

The human eye is insensitive to variations in brightness of high-frequency components over a large area. Therefore, the high frequency values in the image matrix can be rounded off to zero without the user noticing any difference in the quality of the image [7].Quantization achieves this compression by dividing the DCT output for each block by a quantization coefficient, and then rounding the result into the closest integer [7]. The 8x8 quantization matrix used in this paper is

3. ALGORITHM

Complexity of EBMA: In this paper an operation is considered as one subtraction, one addition or calculating one absolute difference, the total number of operations for – Calculating the Minimum Absolute Difference for each block is N^2 Calculating the disparity for one block is (2R+1)^2N^2 where, the block size is assumed to be NxN pixels and the search size is ± R pixels. 2.4.2 Algorithm: The blocks will have M rows and N columns and the search size is assumed to be ± R pixels. The parameter search_size is the range over which the reference image will search for the best matching block in the second image. This means that if the search size is 8 pixels, the best matching block will be searched over ± 8 pixels relative to the position of the current block. The x-component and the y-component of the image vectors were stored in mvx and mvy respectively. Therefore, mvx(i, j) stores the x-component of the disparity vector corresponding to (i,j) -th and mvy (i,j) stores the y-component of the disparity vector corresponding to the particular block. The algorithm to estimate the disparity is – Step 1 determine the size of the reference frame – refImage. Step 2 calculate the size of disparity vectors mvx and mvy, based on the size of refImage, M and Step 3 for each 8x8 block in refImage do i. Extract the block from refImage ii. Search the second image, over a region of ± R pixels relative to the position of the current block and calculate the sum of absolute difference between the pixels of the reference image and the second image. The minimum SAD is the best matching block. iii. The difference between the reference image and the second image is the disparity vector for the two images. This value is stored in the appropriate locations in mvx and mvy.

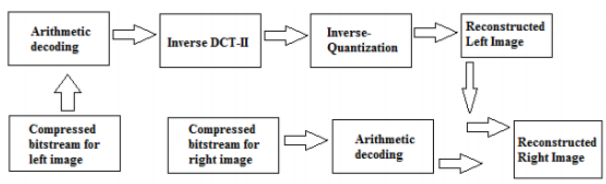

Figure 3: Reconstructing the Image

4. ARITHMETIC DECODING

The pseudo code for arithmetic decoding is – low <- 0; high <- 1; x <- encoded number while (Sn!=0) do Sn<- Decode next symbol in x; Print Sn; x <- (x-CDF(n-1))/(CDF(n)-CDF(n-1)); end 3.2 Inverse Quantization The image matrix is divided into 8x8 blocks and each block is multiplied by the Quantization matrix in (3). This is step is referred to as inverse quantization even though quantization cannot be inversed as it is lossy [6]. 3.3 Inverse Transform The image is divided into NxN blocks and the inverse 2-D DCT of each pixel is calculated as –

5. CONCLUSION

A method to compress stereo images using four algorithms – DCT-II, quantization, arithmetic encoding and exhaustive block matching algorithm was proposed in this paper. Four pair of images were compressed and then reconstructed by reversing the steps followed to compress the images. The reconstructed images were then compared with the original images.

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