



A Survey on Enhancing Compression Ratio in JPEG algorithm

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Abstract— To store an image, large quantities of digital data are required. Hence storage capacities exceed the availability of bandwidth of communication. Due to limited bandwidth, image must be compressed before transmission. JPEG (Join Photographic Expert Group) is widely used algorithm now-a-days for compressing Gray-scale or colour images. In this algorithm, according to quality parameter, compression is done. Quality parameter is an integer number from 1 to 100. As quality parameter is high, then compressed image size is large, so compression ratio is low. While lower the quality parameter, higher the compression ratio. This paper presents various techniques for increasing the compression ratio without affecting quality parameter. Hence fewer quantities of digital data are required.

Keywords— Image, Image Compression, JPEG, Compression Ratio, DCT, Hybrid DCT and DWT, Shuffle Algorithm

I. INTRODUCTION

Digital systems represents that an image is a 2 Dimensional signal. Normally an unprocessed image i.e. image taken from the camera is in the analog form. But for various purposes like for processing, transmitting and storage, images are converted in to digital form. A Digital Image is basically in the form of 2- Dimensional array of pixels [1]. Basically Image compression is different process than compressing digital data. General purpose Data compression algorithm can be used for Image compression but the result is less optimal. Uncompressed multimedia data like graphics, audio and video requires high storage capacity and transmission bandwidth. Sometimes storage capacities exceed the availability of bandwidth of communication. So different types of images are used in remote sensing, bio medical and video processing techniques which require compression for transmission and storage. Compression is achieved by removing redundant or extra bits from the image.

II. OVERVIEW OF JPEG

In the general case, the JPEG compression algorithm includes the following steps:

1. Color space conversion;
2. Chroma subsampling;
3. Segmentation into blocks;
4. Discrete Cosine Transform;
5. Quantization;
6. Encoding.

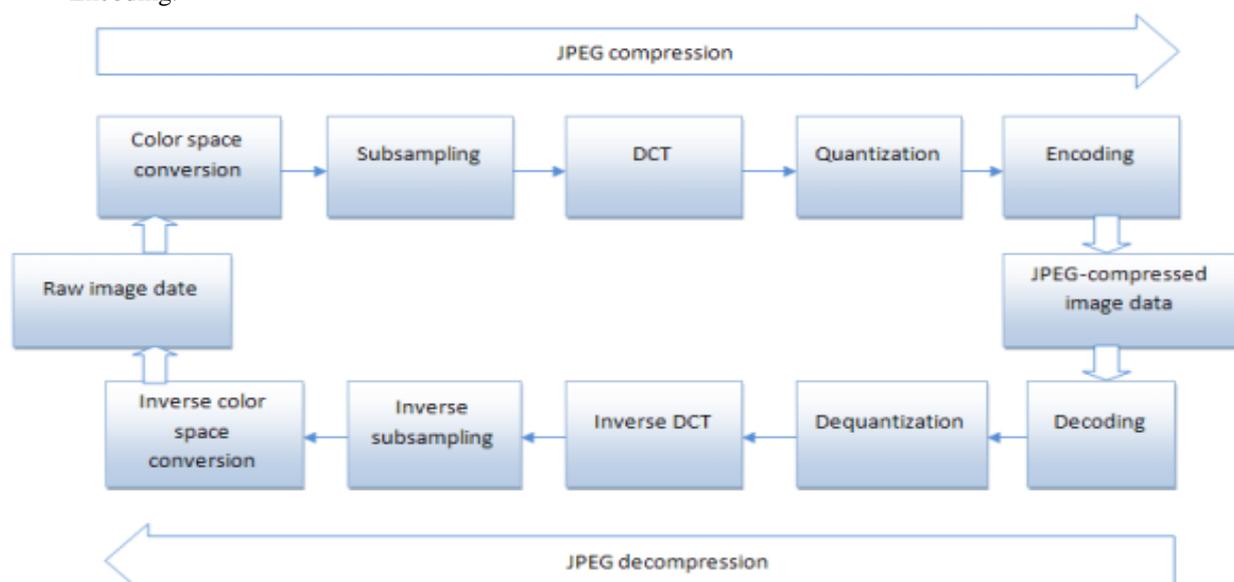


Fig. 1 Jpeg image compression and decompression

1. Color Space Conversion

On this step the colors of the RGB (Red, Green, Blue) image are converted to YCbCr (Luminance, Chrominance Blue, Chrominance Red). During this conversion we take three standard channels (RGB) and convert them into a different representation which is based on a luminance (brightness) channel and two opposing color channels. These three channels are typically less interdependent than the RGB channels. That allows us to store them with different resolution. If the image is CMYK or grayscale, it is processed without any color conversion [2].

2. Chroma Subsampling

It is widely known that we are much more sensitive to changes in luminance than in chrominance. It means that we may neglect larger changes in the chrominance without affecting our perception of the image. Therefore, we can store the color information at lower resolution than the luminance information. This method can be applied only to images in YCbCr color space. CMYK images use all the channels to store color information. Therefore each color channel is compressed and quantized with the similar quality. Grayscale images have no color information and do not need being converted. Graphics Mill provides a functionality to change chrominance resolution during the compression [2].

3. Segmentation into Blocks

The image is divided into 8 by 8 blocks of pixels. Since each block is processed without reference to the others, further steps will be described relatively to a single block [2].

4. Discrete Cosine Transform

Each of the color component data (e.g. Y, Cb, Cr for YCbCr or C, M, Y, K for CMYK) undergoes the Discrete Cosine Transform (DCT). A DCT operation on a block of pixels produces coefficients that are similar to the frequency domain coefficients produced by a DFT operation [2].

5. Quantization

The amplitudes of the frequency components are quantized. The human vision is much more sensitive to small variations in color or brightness over large areas (low-frequency components) than to variations which occur on every pixel (high-frequency components). Therefore, the high-frequency components are stored with a lower accuracy than the low-frequency ones. The quality setting of the encoder affects the resolution of each frequency component. Higher values of quality setting correspond to higher quality images and larger file sizes [2].

6. Encoding

The resulting data for all 8 by 8 blocks of pixels is compressed with a lossless algorithm, a variant of Huffman encoding [2].

The decompression process consists of all these steps but uses them in the inverse order.

III.COMPRESSION TECHNIQUES

A. A hybrid image compression technique based on DWT and DCT transforms

In this method, data compression for images using hybrid DWT-DCT is used which performs discrete cosine transformation on the discrete wavelet transformed coefficients. This method gives high compression ratio, preserving most of the image information and the image is reproduced with good quality. In this method, three case studies has been discussed so that the most suitable case for a particular application can be taken and implemented. The compression ratio that is obtained from this method is more when compared to currently used standards of Image compression, preserving most of the image information. The first case has a very high compression ratio; but for getting that the clarity of the image is partially traded off. Second case is more suitable for regular applications as it is having a good compression ratio along with preserving most of the information. In the third case, more importance is given to the image information [3].

B. A multi-objective evolutionary approach to image quality/compression trade-off in JPEG baseline algorithm

The JPEG algorithm is one of the most used tools for compressing images. The main factor affecting the performance of the JPEG compression is the quantization process, which exploits the values contained in two tables, called quantization tables. The compression ratio and the quality of the compressed images are determined by these values. Thus, the correct choice of the quantization tables is crucial to the performance of the JPEG algorithm. In this method, a two-objective evolutionary algorithm is applied to generate a family of optimal quantization tables which produce different trade-offs between image compression and quality. Compression is measured in terms of difference in percentage between the sizes of the original and compressed images, whereas quality is computed as mean squared error between the reconstructed and the original images. We discuss the application of the proposed approach to well-known benchmark images and show how the quantization tables determined by our method improve the performance of the JPEG algorithm with respect to the default tables suggested in Annex K of the JPEG standard [4].

C. Improved Image Compression Algorithm Using Binary Space Partition Scheme and Geometric Wavelets

Geometric wavelet is a recent development in the field of multivariate nonlinear piecewise polynomials approximation. This method improves the geometric wavelet (GW) image coding method by using the slope intercept representation of

the straight line in the binary space partition scheme. The performance of the proposed algorithm is compared with the wavelet transform-based compression methods such as the embedded zero tree wavelet (EZW), the set partitioning in hierarchical trees (SPIHT) and the embedded block coding with optimized truncation (EBCOT), and other recently developed "sparse geometric representation" based compression algorithms. The proposed image compression algorithm outperforms the EZW, the Band lets and the GW algorithm. The presented algorithm reports a gain of 0.22 dB over the GW method at the compression ratio of 64 for the Cameraman test image [5].

D. Two-Dimensional Orthogonal DCT Expansion in Trapezoid and Triangular Blocks and Modified JPEG Image Compression

In the conventional JPEG algorithm, an image is divided into eight by eight blocks and then the 2-D DCT is applied to encode each block. In this method, we find that, in addition to rectangular blocks, the 2-D DCT is also orthogonal in the trapezoid and triangular blocks. Therefore, instead of eight by eight blocks, we can generalize the JPEG algorithm and divide an image into trapezoid and triangular blocks according to the shapes of objects and achieve higher compression ratio. Compared with the existing shape adaptive compression algorithms, as we do not try to match the shape of each object exactly, the number of bytes used for encoding the edges can be less and the error caused from the high frequency component at the boundary can be avoided. The simulations show that, when the bit rate is fixed, our proposed algorithm can achieve higher PSNR than the JPEG algorithm and other shape adaptive algorithms. This proposed method can also be used for generating 2-D complete and sine basis, walsh basis and discrete polynomial basis in a trapezoid or a triangular block [6].

E. An Approach to Improve JPEG for Lossy Still Image Compression

The compression ratio of lossless methods (e.g., Huffman, Arithmetic, LZW) is not high enough for image and video compression, especially when the distribution of pixel values is relatively flat. The lossless encoding schemes can be used as the final step for the lossy compression. In JPEG technique an input image is decomposed with the DCT, quantized and end of block coded to give input symbol sequence. Then JPEG uses entropy coding to compress the image data. In this paper, the proposed method performs a modification at this stage. When the whole image is encoded after applying the entropy (JPEG-like Huffman) encoding, the bit stream of the image is created. Then we split the bit stream into 8bits blocks and the generation of blocks is done until the whole bits are accommodated with the blocks. After completing the block creation of the whole stream, another compression encoding technique is applied on these blocks, so the average bit rate of each block will be reduced and better compression ratio can be achieved [7].

F. Colour image compression based on dct blocks

This method presents the performance of different block based discrete cosine transform (DCT) algorithms for compressing color image. In this RGB component of color image are converted to YCbCr before DCT transform is applied. Y is luminance component; Cb and Cr are chrominance components of the image. The modification of the image data is done based on the classification of image blocks to edge blocks and non-edge blocks, then the edge block of the image is compressed with low compression and the nonedge blocks is compressed with high compression. The analysis results have indicated that the performance of the suggested method is much better, where the constructed images are compressed with higher factor [8].

G. Shuffle Algorithm for Lossless Compression Method of JPEG File

The degree of compression can be adjusted allowing a selectable trade of between storage size and image quality. There is an optional lossless mode defined in the JPEG standard. Image of JPEG format has high image quality characteristics, which is widely used in image transmission of computer storage and computer networks. The existing ordinary digital photos mostly use JPEG format. Because the quality of JPEG image is high, it occupied space is relatively large. The compression effect of existing lossless compression algorithm for JPEG file is poor. This method introduces lossless compression method combined by shuffle algorithm and lossless compression algorithm and proposes a novel algorithm. There were two existing methods so called lossless compression and lossy compression. This proposed method obeys both the algorithm advantages. The novel approach is called shuffle algorithm which effectively structure the JPEG image file before compression, then combining with common lossless compression algorithm can remove inside information redundancy. Shuffle algorithm is resetting the data bits and arranges bits into another arrangement. There are many shuffle functions, such as uniform shuffle, the first k-th subshuffle, the kth ultra shuffle, etc.. Then anti-shuffle function will transform original arrangement into the sequence [9].

H. An Improved JPEG Image Compression Technique based on Selective Quantization

Lossy Sequential DCT Mode of JPEG is most popular since it can store a digital image by temporarily removing its psycho visual redundancy and thereby offering a very less storage space for a large image. This method explores the fact and introduces an improved technique that modifies the Baseline JPEG algorithm. It describes a way to further compress a JPEG image without any additional loss while achieving a better compression ratio than that is achievable by Baseline JPEG This technique is tested on over 200 textbook images that are extensively used for testing standard Image Processing and Computer Vision algorithms. This method achieves 2:15% and 14:10% better compression ratio than that is achieved by Baseline JPEG on an average for Gray-scale and true-color images respectively [10].

IV. CONCLUSION

Now-a-days JPEG is most widely used technique for compressing images. This paper presents various types of techniques which are improving compression ratio in JPEG algorithm.

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