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Multi-Channel Image Compression Using JPEG-DCT with LAB Color Model

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***Abstract*—The rapid growth of digital imaging applications, including desktop publishing, multimedia, teleconferencing, and high definition television (HDTV) has increased the need for effective and standardized image compression techniques. Lots of techniques are available for the Single channel image compression i.e. for black and white images. But rapid growth in modern communication demands the direct transmission and storage of Multichannel images i.e. Color images. This arises the need of effective and standardized Multichannel image compression technique. The aim of this paper is to develop and implement an algorithm for compression of multichannel image i.e. color images as well as to speed up the compression of multichannel images with high compression. This paper presents a new method of implementation of available JPEG-DCT technique for multichannel (i.e. Color) image compression using LAB Color Model. The proposed algorithm first divides the multichannel image into its consecutive single channel components, and then single channel JPEG-DCT image compression is applied over each single channel component separately. This leads to the effective solution of the development of multichannel JPEG i.e. multichannel image compression.**

Keywords*—*Discrete cosine transform , color image compression , LAB color model.

1.INTRODUCTION

Image compression addresses the problem of reducing the amount of data required to represent a digital image .The underlying basis of the reduction process is the removal of redundant data. From a mathematical view point, this is a process of transforming a 2-D pixel array into a statistically uncorrelated data set .The transformation is applied prior to storage or transmission of the image [1].Currently image compression is recognized as an “enabling technology”. In addition to the areas just mentioned, image compression is the natural technology for handling the increased spatial resolution of today’s imaging sensors and evolving broadcast television standards. image compression plays a major role in many important and diverse applications, including televideoconferencing, remote sensing (the use of satellite imagery for weather and other earth resource applications), document and medical imaging facsimile transmission (FAX) [2],[3], and the control of remotely piloted vehicles in military, space and hazardous waste management applications.

2. IMAGE COMPRESSION USING DISCRETE COSINE TRANSFORM

Discrete cosine transform (DCT) is widely used in image processing, especially for compression. Some of the applications of two-dimensional DCT involve still image compression and compression of individual video frames. Since the late 1980's The JPEG standard has been an effective first solution to the standardization of image compression [4],[5] . Although JPEG has some very useful strategies for DCT quantization and compression, it was only developed for low compressions. The 8×8 DCT block size was chosen for speed (which is less of an issue now, with the advent of faster processors) not for performance [6].

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2.1 JPEG COMPRESSION

First, The JPEG (Joint Photographic Experts Group) standard has been around for some time and is the only standard for lossy still image compression. There are quite a lot of interesting techniques used in the JPEG standard and it is important to give an overview of how JPEG works. There are several variations of JPEG, but only the 'baseline' method is discussed here.

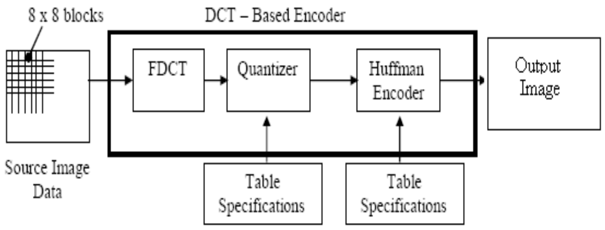

Figure (1) JPEG Encoder

As shown in the Figure (1) :

- The source image is first partitioned into non-overlapping 8 × 8 blocks.
- A Forward Discrete Cosine Transform (FDCT) is applied to each block to convert the spatial domain gray levels of pixels into coefficients in frequency domain.
- To improve the precision of the DCT the image is 'zero shifted', before the DCT is applied. This converts a 0→ 255 image intensity range to a -128→ 127 range, which works more efficiently with the DCT. One of these transformed values is referred to as the DC coefficient and the other 63 as the AC coefficients [4].
- After the computation of DCT coefficients, they are normalized with different scales according to a quantization table provided by the JPEG standard conducted by psycho visual evidence.
- The quantized coefficients are rearranged in a zigzag scan order for further compression by an efficient lossless coding algorithm such as run length coding, arithmetic coding, Huffman coding.

  The decoding process is simply The inverse process of encoding as shown figure (1).

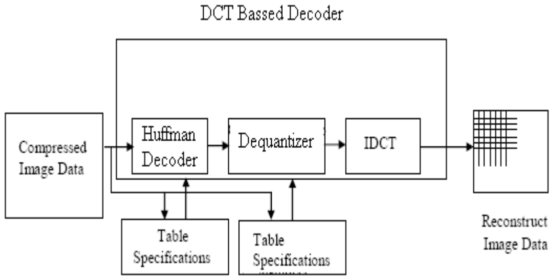

Figure (2). JPEG Decoder

3.METHODOLOGY

The methodology of proposed algorithm is mainly based on the concept JPEG-DCT that is implement for multichannel images through just dividing the multichannel image into its consecutive single channel components, and then the use single channel JPEG over the each single channel components separately will leads to the solution of the development of multichannel JPEG i.e. multichannel image compression.

The developed algorithm is discussed below step by step with the help of flow graph shown in the Figure (3).

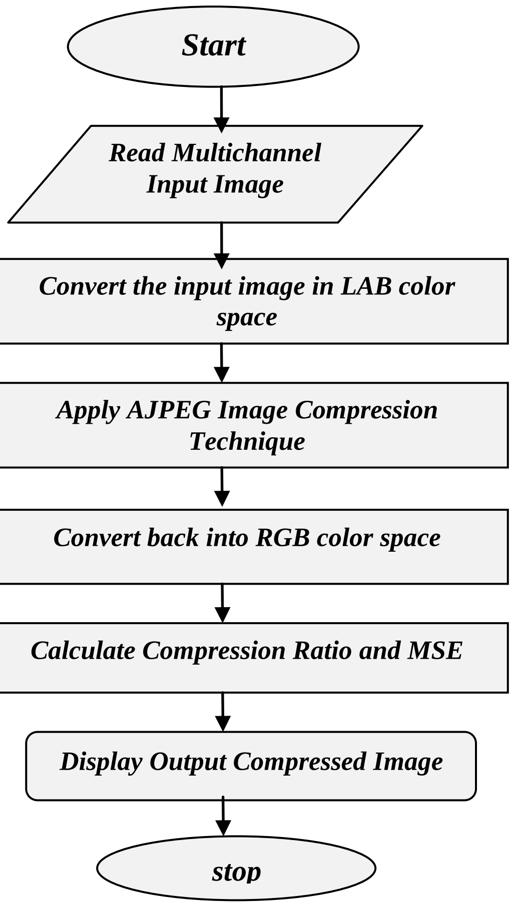

Figure (3). Flowchart for AJPEG Image Compression Technique

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4. RESULT & DISCUSSION

The algorithm has been successfully developed and implemented in MATLAB to develop an efficient multichannel image compression. Now we will show & discuss the various results obtained from the developed algorithm. Since it is not possible to evaluate the performance of any algorithm on the basis of single image, hence for the performance evaluation of the developed algorithm two different multichannel images has been used. These images are shown in figure (4) fig and figure (5). To compare the results obtained from the developed algorithm two most important image compression parameters are used.

1) Compression Ratio.

2) Mean Square Error.

To show the compression and decompression process by using developed algorithm on first input image i.e. Autumn.tif. Whose size is 206X345 and memory requirement to store is 71070 bytes shown in figure (4). For the performance evaluation of developed algorithm on compression and decompression processes, the value of parameter quality is fixed to 5. ie during the compression process we will remove only 5% information from the original input image. The results obtained after the compression and decompression process are shown from figure (4.1) and figure (4.2).

Figure (4): First Image (autumn.tif) Size 206X345 and memory requirement to store is 71070 bytes.

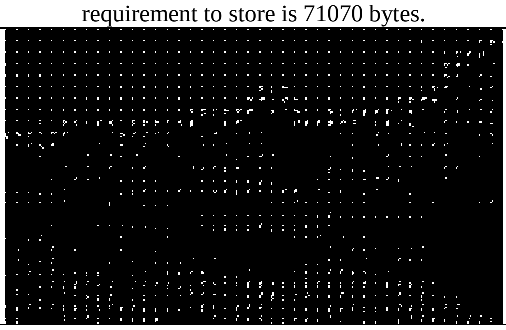

Figure (4.1): First Compressed Image (autumn.tif) Size 206X345 and memory requirement to store is 67872 bytes

Figure (4.2):First decompressed Image (autumn.tif) Size 206X345 and memory requirement to store is s71070 bytes.

The compression parameters obtained after first input image compression and decompression process are as follows.

1.	**Bi (size of first input image in bytes)**	**71070 bytes**
2.	**Bc (size of first compressed image in bytes)**	**60640** bytes**.**
3.	**Bo (size of first decompressed image in bytes)**	**71070 bytes.**
4.	**Cr1 (Compression Ratio)**	**177.8974**
5.	**R.M.S.E1 (Between original & decompressed Image)**	**29.9831**

Similarly the results obtained for second input image ie. (lena.jpeg), who's Size, is 415X445 and memory requirement to store is 180525 bytes are shown from figure (5.1) and figure (5.2).

Figure (5): Second Image (lena.jpeg) Size 415X445 and memory requirement to store is 180525 bytes.

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Figure (5.1): Second Compressed Image (lena.jpeg) Size 415X435 and memory requirement to store is 123704 bytes.

Figure (5.1): Second Decompressed Image (lena.jpeg) Size 415X435 and memory requirement to store is 123704 bytes.

The compression parameters obtained after second input image compression and decompression process are as follows.

1.	**Bi (size of first input image in bytes)**	**180525 bytes**
2.	**Bc (size of first compressed image in bytes)**	**142712 bytes.**
3.	**Bo (size of first decompressed image in bytes)**	**180525 bytes.**
4.	**Cr1 (Compression Ratio**	**193.4369**
5.	**R.M.S.E1 (Between original & decompressed Image)**	**39.5436**

5. EFFECT OF PARAMETER QUALITY ON IMAGE COMPRESSION

Up to this stage we have considered the JPEG parameter "Quality" as a constant. Now in this section we will discuss the effect of variation on Quality on the image compression processes, and for that we will show some statistical analysis, like the effect of quality on compression ratio and Error. To examine the effect of variation in quality on compression ratio and error, let us again consider first input image as shown in Figure (4). Now the resultant decompressed images for various values of quality are shown below form Figure (6) to Figure (8). From the Figure (6) to Figure (8) it has been clear that as we increase the parameter quality the visual degradation will increase in resultant reconstructed images at the receiving end.

Figure (6) Decompressed image for quality = 2

Figure (7) Decompressed image for quality = 10

Figure (8) Decompressed image for quality = 30

6. CONCLUSION

In this modern era during transmission and reception, the image storage plays very important and crucial role. In the present scenario the technology development wants fast and efficient result production capability. This paper presented an algorithm for real time multichannel image

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compression especially for three channel i.e. for color images.

The developed algorithm is found very efficient for compression. Perhaps the image compression using the JPEG standard is not an independent process, its dependent on JPEG parameter known as "Quality". To show the effect of this parameter on color image compression, some statistical analysis has been also done in the paper. According to results of that analysis it is found that as the parameter value increases the compression ratio and Mean square error both are increases. For higher compression ratio we have to select high value of parameter Quality, but the higher value of parameter provides higher Mean square error. Therefore we have somewhat compromise here with the compression ratio and Mean square error. This leads the requirement of the range of values of parameter Quality that can provide good compression ratio with less error. The

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