Color Image Compression with Image Enhancement using Discrete Cosine Transform

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Abstract: An image is depiction that can be generated, duplicated and saved in any electronic form. Image Compression is a technique that is used to decline the intensity of a graphical file.JPEG is trivial standard that is used for computer images .DCT is a mechanism that is used to split an image into various sectors of frequencies. Image Enhancement is a mechanism that is used to alter the image for increasing contrast, for lessening noise and to smoothen the image so that it produces a finer image for display. A technique that is used to upgrade the brightness of an image is called Histogram equalization. In this paper, the JPEG-DCT image compression scheme with image enhancement is presented to compresses and decompresses the color images. Image compression and Image Enhancement are two significant steps that execute the essential methods in image processing. In the proposed scheme the image is converted andenhanced using a Histogram equalization technique and compressed using a JPEG compression algorithm. The proposed scheme aims to accomplish greater compression ratio and finer quality.

***Keywords**: Image Compression; JPEG, Histogram Equalization, Discrete Cosine transform.*

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I. INTRODUCTION

Image compression is a technique that is used to lessen the size of the file without diminishing the image quality. This minimization of information allows further images to be saved in the memory space or disk. Image compression technique is based on two different categories that are lossy compression and lossless compression.

Lossy Compression

In this technique the data is lost. After the data has been compressed the initial data cannot be retrieved or restored. This technique is used for image and sound compression. MP3 file formats and MPEG video formats are examples of lossy compression.

Lossless Compression

In this technique the data is not lost. If data is compressed, it can be retrieved. Text compression uses lossless compression. Fax Machine and Radiology are instances of Lossless Compression.

JPEG is a typical image file format that is standardized by Joint Photographics Experts Group (usually refers to JPEG) are used in many digital cameras. It is adopted to compress the decompress the Image. The common file formats of JPEG are.jpg or .jpeg.In this Paper Compression is carried out on the enhanced image by the proposed method to achieve larger compression ratio and finer quality.

A process that improves the visual perception so that it produces a more relevant image than that of the original image is called Image Enhancement. The two methods of Image Enhancement are spatial domain or frequency domain. Spatial domain techniques are executed on the image pane itself they are based on explicit use of pixels in an image. Frequency domain techniques enhance the image by transforming by a continuous position invariant operator. A major technique of spatial domain is Histogram Equalization (HE) that is used to upgrade the contrast of the image. HE evenly distributes the values of the pixel within a range so the output image's histogram matches with the input image's histogram. [3].

JPEG standard performs better compared to other previous standards like JPEG-LS, PNG and MPEG. Where JPEG-LS do not support any purpose like error resilience and scalability, PNG does not support large image files and lossless coding are not supported in MPEG. Thus JPEG supports both lossless compression and lossy compression.

II. RELATED WORK

A.H.M. Jaffar Iqbal Barbhuiya, Tahera Akhtar Laskar and K. Hemachandran [1] state the comparison between discrete wavelet transform and discrete cosine transform. First the image is divided into 8*8 block then the transformation is applied to the block. Then the DCT Coefficients are quantized using a quantization technique that reduces the amount of information. The quantized coefficients are encoded using any of the entropy coding techniques such as Run length coding, Huffman coding or arithmetic coding. Then again the image is compressed using discrete wavelet transform. This decomposes the images into three levels of segments. Then quantization is applied to reduce the amount of information. Thus quantized coefficients are encoded using several entropy coding techniques. Thus discrete wavelet transform achieves higher compression ratio without degrading the quality of the image.

A.M. Raid, W.M.Khedr, M. A. El-dosuky and Wesam Ahmed [2] state the JPEG Compression using DCT. First the image is converted from RGB color space to YUV color space. Then discrete cosine transform is applied on the image. The results of DCT are quantized using a Uniform quantizationto reduce the number of bits and to compress the image more efficiently. Then zigzag scan is used to scan the less frequent coefficients. The quantized coefficients are encoded using any of the encoding techniques. The reverse

process of the compression phase is used to decompress the image.

Surabhi N and Sreeleja N Unnithan [4] state that the basic concept of image compression, First the image is encoded by the encoder where the image is converted into bit streams then the bit stream is decoded. This bit stream is produced as an output image .When the output image has higher compression ratio than the bit stream, and then image compression occurs. Different types of redundancies are removed by assigning less number of bits to more frequent grey levels and then assigning more number of bits to less frequent grey levels. Various lossless compression techniques such as Huffman Encoding, Run Length Encoding Arithmetic Coding, Entropy Encoding, Lempel–Ziv–Welch Coding and lossy compression techniques such as Predictive coding and Transform coding are discussed.

Ridhi Jindal [5] states the various techniques that can be applied to different images. An image is a 2D array of pixels. A pixel is single point in a raster image. An RGB pixel consists of three dots of light each corresponds to the brightness of the particular color. A YUV color space consists of Ycbcr components. Several lossy compression techniques are discussed. Transformation coding is used to change the pixels in the original image into frequency domain coefficients. Vector Quantization is a usually a block of pixel values. A given image is then partitioned into non-overlapping blocks (vectors) called image vectors. Fractal Coding the essential idea here is to decompose the image into different segments by using different processing techniques such as color separation, edge detection, and texture analysis. In Block Truncation Coding the image is divided into non overlapping blocks of pixels. Various techniques are also included in lossless compression such as Run Length Encoding. It replaces sequences of identical pixels called runs by shorter symbols. Huffman Encoding is a general technique for coding symbols based on their statistical occurrence frequencies.LZW (Lempel-Ziv–Welch) is a dictionary based coding. Dictionary based coding can be static or dynamic. Area coding is an enhanced form of run length coding, reflecting the two dimensional character of images**.**

Juncai YAO, and Guizhong LIU [6] states that color image compression use contrast sensitivity characteristics of human visual system. First the image is converted from RGB color space to YUV color space. Then the image is divided into three components such as luminance, red-green, Yellow-blue. Then each component is divided into 8*8 block. The DCT transform is carried out for each of the blocks in three components. Then, three quantization matrices based on the CSF model are built, and the frequency spectrum coefficients of three component images are selectively quantized using the matrices. Finally the quantized coefficients are encoded using the Huffman Algorithm**.**

III. PROPOSED WORK

This paper proposes the JPEG color image compression with image enhancement employing Discrete Cosine Transform. The proposed scheme initially converts the image to YUV color space from an RGB color Space as human eyes are sensitive to chrominance rather than luminance. Then the converted image is enhanced and it is divided into 8*8 blocks. For each block DCT (Discrete cosines transform) is applied. The coefficients generated by the DCT are qunatized.Uniform Quantization is a technique where the compression is done to a greater extent. Then Huffman coding is adopted to encode the coefficients generated by the uniform quantization**.** Huffman Coding is lossless compression algorithm that assigns variable length code to input characters. The variable length code that is assigned to the input characters is called prefix code. The code that is assigned to one character will not be the code for some other character. If the input character appears more frequently they are assigned as smallest code whereas if the input character appears least frequently then it is assigned as largest code. Huffman Coding generates bit stream. Thus the compressed image will be retrieved. Decompression is the reverse process of compression. Various metrics such as the peak signal to Nose ratio (PSNR) and Compression ratio (CR) is carried out to compare the compressed image with the original image (7).

$$MSE = \frac{1}{axb} \sum_{b=1}^{a} \left(m_{ij} + n_{ij}\right)^2 \quad (1)$$

$$PSNR = 20.\log_{10}\left(\frac{\text{MAX}\sqrt{}}{\sqrt{\text{MSE}}}\right) (2)$$

$$CR = \frac{sizeoft\ hecompressedimage}{sizeoft\ heorginalimage} \quad (3)$$

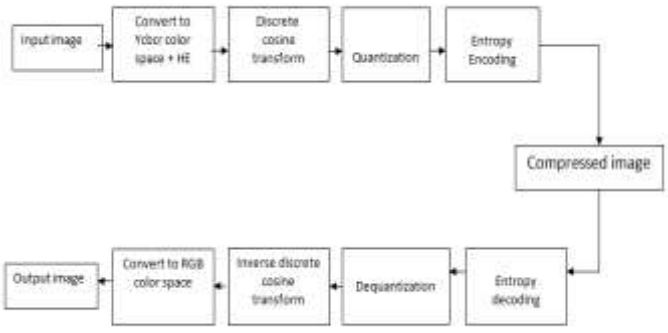

Fig.1 Proposed Method Taxonomy

IV. EXPERIMENTAL RESULTS

The proposed scheme first converts the input image from RGB color space to YUV color space as Fig.2

 ISSN: 2454-4248
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Fig.2 output of RGB to YUV color space

Then the image is enhanced using a histogram equalization technique as shown in Fig.3

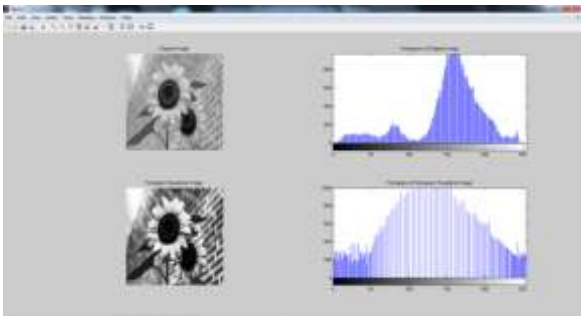

Fig.3. output of enhanced image

The enhanced image is compressed using a jpeg compression algorithm after that DCT is applied on the enhanced image and IDCT is also applied as shown in Fig.4

Fig.4. output of DCT and IDCT

Then in the DCT image, quantization is applied which quantizes the image Then dequantization is also applied to retain the DCT based image as shown in Fig.5

Fig.5. Output of quantization and dequantization

Huffman coding encodes and decodes the quantized image. Thus the decoded image is converted to RGB color space from YUV color space as shown in Fig.6

Fig.6. Output of decoded image

V. PERFORMANCE ANALYSIS

This paper proposes the JPEG color image compression with image enhancement employing Discrete Cosine Transform. Various performance metrics are calculated such as PSNR (Peak signal to Noise Ratio) is used to find the ratio between the maximum possible pixel value of an image and of corrupting noise that affects the fidelity criteria of an image.MSE (Mean Square Error) is the cumulative squared error between the compressed image and the Original image. It will measure the quality of compressed image and Compression Ratio (CR) is used to find the ratio between the original image and the corresponding compressed image (7). Thus the results indicate that the proposed scheme performs better than JPEG image compression algorithm.

 ISSN: 2454-4248
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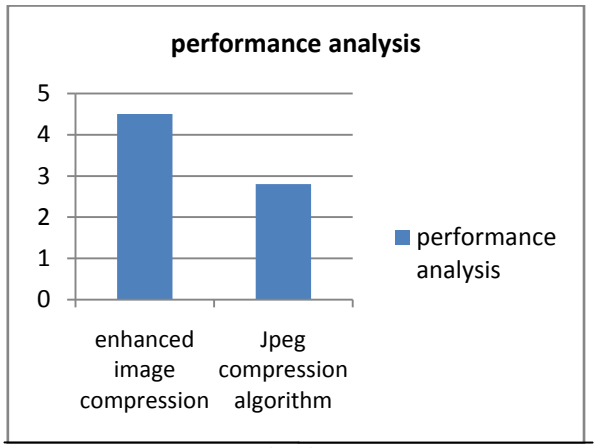

Fig.7. Results of performance analysis

VI. CONCLUSION

This paper discusses the enhanced image compression that is adopted for color images. The aim is to obtain higher compression ratios and display images in finer quality. Here the image is compressed by adopting techniques like DCT, quantization and entropy coding. The inverse process is adopted to retrieve the input image. We calculated different performance matrices such as PSNR and CR for both JPEG compression and proposed method. Thus the results show the proposed scheme attains finer image quality by increasing CR as well as PSNR of compressed image.

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