Color Image Compression Using Colorization Based On Coding Technique

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Abstract- *Image compression and decompression is now days widely used in different real time applications. It is the technique that uses lossy or lossless coding to reduce the storage space required for image information by removing spatial redundancy. Image Compression is useful for storage and transformation of images as it helps reduce the hard disk space and transmission bandwidth. The major problem with the colorization-based coding is the extraction of the representative pixel set such that compression rate as well as the quality of the reconstructed color image remains good. We are solving this problem by formulating the colorization based coding problem into an optimization problem, so that the selected RP set is smallest. In addition to this proposed method we are constructing the colorization matrix that colorizes the image in a multiscale manner. This, combined with the proposed RP extraction method, allows us to select a very small set of RP. This approach can improves the performance of proposed colorization method; however this method may takes more execution time and cost. Therefore to reduce execution efforts and cost, we are applying to use this method with parallel programming. Parallel programming is used to speed up the coding execution for image processing in MATLAB. Experimentally it is observed that with the above proposed method, we can drastically suppress the amount of information compared to conventional image compression methods, while maintaining the quality of the objective image.*

Keywords- Image Compression, Colorization, reconstruction of color image

I. INTRODUCTION

Internet plays a very vital role now days in our day today life and thus uses of multimedia applications have been drastically increased. The growth of multimedia applications has led to the development of new techniques for image compression. Colorization based compression is a method to compress a color image preserving its color components and reconstructing the color image .In colorization based coding few representative pixels are extracted which provides the color information for all the other pixels in the image. It is a method to compress a color image preserving its color components and reconstructing the color image. The fundamental issue in colorization based coding is the way to obtain the RP set with the goal that the Compression rate and the quality of the restored color image get good. A few strategies have been proposed to this end [1]–[4]. All these strategies take an iterative methodology. In these strategies, in the first place, an irregular set of RP is chosen At that point, a provisional color image is remade utilizing the RP set, and the nature of the remade color image is assessed by contrasting it with the first color image. Additional RP are obtained from areas where the quality does not fulfill a certain rule utilizing RP extraction systems, while redundant RP are diminished utilizing RP reduction methods.

However, the set of RP may in any case hold repetitive pixels or some needed pixels may be missed.The proposed method uses the concepts of colorization matrix construction, meanshift segmentation, and RP set extraction which selects the best optimal solution for decompressing the image with best PSNR results. In addition to this, to overcome the drawback of existing method of colorization based compression, we are introducing the use of parallel programming with this method to reduce the total computation time, cost and memory usage. We are focusing to improve the execution time so that amount of memory will get reduced for compression and decompression processing.

II. LITERATURE SURVEY

Previously, various methods were suggested for color image compression using colorization. In [9], Levin et al's uses a colorization algorithm, in which few representative pixels are used for reproduction of the colors in the decoder . Emulating the documentation in [8], we signified y as the luminance vector, u as the result vector, i.e., the vector holding the color parts to be remade in the decoder, and x as the vector which holds the color qualities just at the positions of the RP, and zeros at alternate positions. The vectors y, u, and x are all in raster-scan order. The cost function characterized by Levin et al. is : $u = A-1x$. In [5], colorization-based coding uses an active learning methodology to obtain RP automatically. Their strategy performs superior to JPEG for color components.

The steps of the strategy are given underneath.

(i) Segment input image into clusters by image segmentation algorithm
(ii) Obtain RP arbitrarily from each cluster.
(iii) Perform colorization by utilizing temporary RP.
(iv) Find out the clusters that have high error between input image and colorized images.
(v) Obtain more RP from high-error clusters.
(vi) Repeat 4–5.

In [8], another colorization-based coding strategy is shown. In past strategies, there is a high probability of obtaining repetitive RP when setting the introductory RP. This methodology decreases the repetition of the introductory RP. On the other hand, if the starting RP don't incorporate pixels needed for suppressing coding errors, such pixels cannot be obtained by just the redundancy reduction process. The method is as follows:
(i) Obtaining initial RP.
(ii) Lessening redundancy of RP.
(iii) Extraction of needed pixels for RP.

In [7], RP is extracted as a set of color line segments. By limiting the RP to a set of color line segments, the amount of data for representing RP is decreased radically while subjective quality is retained. Then again, this method is not assessed with any objective quality metric [6]. Despite the fact that this technique for colorization-based coding out flanks JPEG as far as subjective quality, the decoded chrominance parts lose the local oscillations that the input image had. An extensive number of color assignations are needed to restore these oscillations.

III. DESIGN & IMPLEMENTATION

A. Implemented Method

In the implemented method, we are trying to overcome drawbacks of other color image compression techniques. Most colorization based coding methods try to extract the RP set by using an iterative approach. As iterative methods are used, this method is time consuming. In this system, color image is spitted into it's luminance and chrominance channels. Then the luminance channel is compressed using compression technique. It's discrete Fourier or wavelet coefficients are sent to decoder. In encoding stage, colorization matrix is constructed. Using chrominance values obtained from original image and colorization matrix, RP set is extracted. RP set is send to decoder. In this, by decoder, colorization matrix is reconstructed using decompressed luminance channel. Thus by performing colorization using colorization matrix and RP set, the color image is reconstructed. The quality of the reconstructed image is then evaluated by comparing it with the original color image. For this, we can verify different quality parameters of color image for comparison. Compared to the sets of RP obtained by other conventional colorization based coding methods, which are updated at each iteration, the set of RP in our method is obtained only once and requires no updates.

B. Overall System Diagram

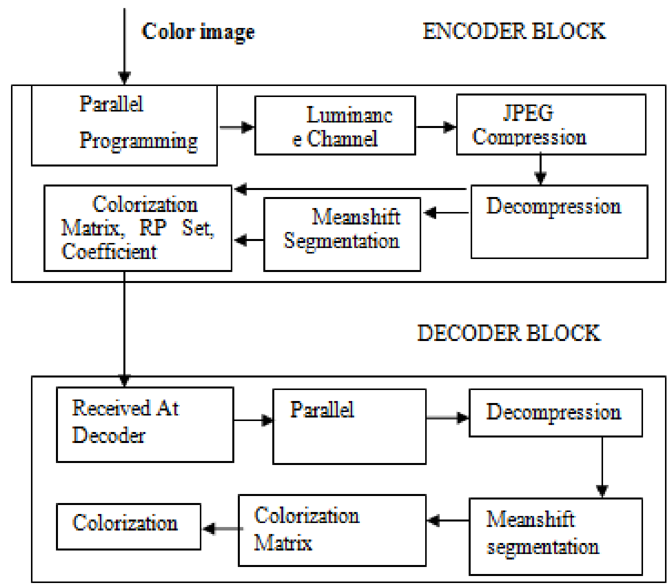

Fig.1. Overall system Diagram

IV. RESULTS

The simulation and implementation of the implemented approach with MATLAB is done. Different Color images are used for performance computation using existing and implemented method. The implemented method is compared with the existing optimization based method and JPEG standards. In the implemented method, 4:1:1 color format is used, which means that the sizes of the reconstructed Cb and Cr chrominance images are one-fourth of the luminance image. To make the visual comparison easy, the colors are constructed with a very small number of coefficients (RP) for all the methods. In the comparison with conventional colorization based coding methods, an uncompressed luminance channel is used in the reconstruction of the color image for all methods. The PSNR measured using all the RGB values of the reconstructed color image together, while the SSIM is measured for the Cb and the Cr channels, separately for the comparison with the JPEG/JPEG2000 standards. Results of standard JPEG/JPEG2000 encoders from other papers are used for comparison. Figure 2(a) to (j) shows the results of the implementation. User clicks on "Select an image file" button to open file selection dialog. File selection dialog is opened and user input color image is selected from a computer.

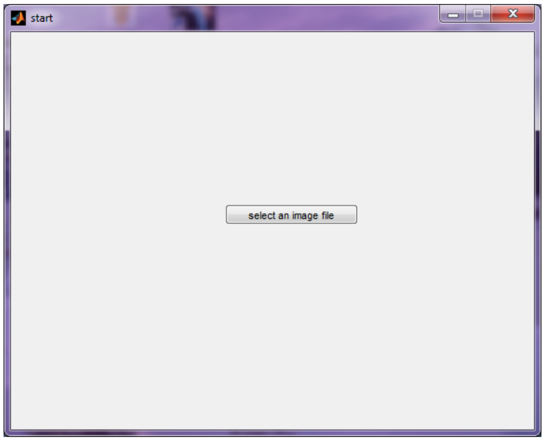

Fig.2 (a) Image selection button

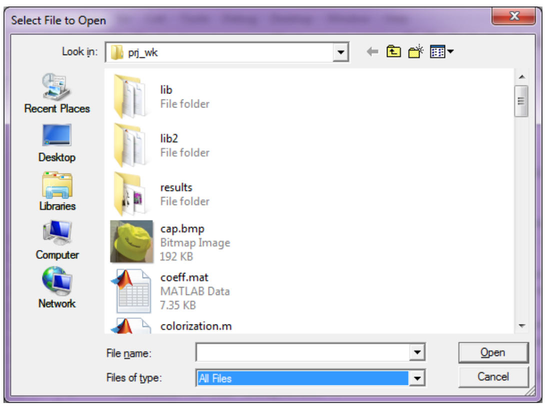

Fig. 2(b) Image Selection Dialog

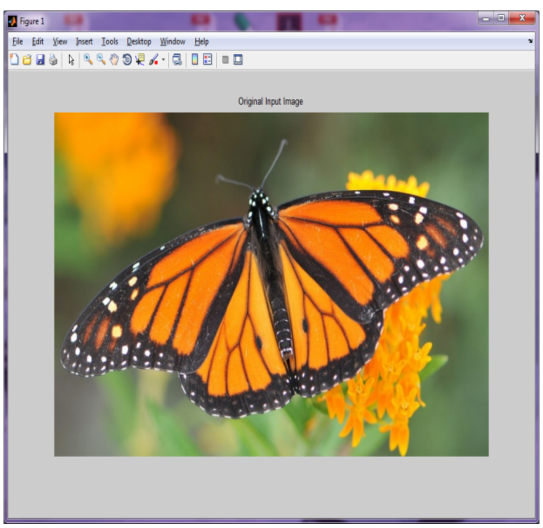

Fig. 2(c) Original Input Image

A. Results of An Encoder Model

Luminance channel & chrominance channel are separated from the input image.

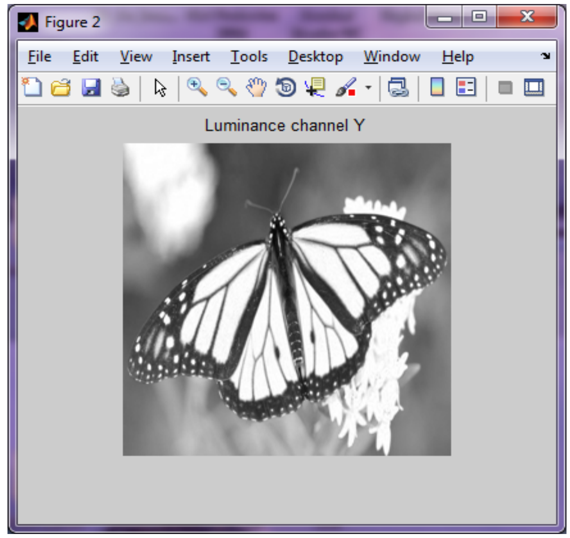

Fig. 2(d) Extracted luminance channel

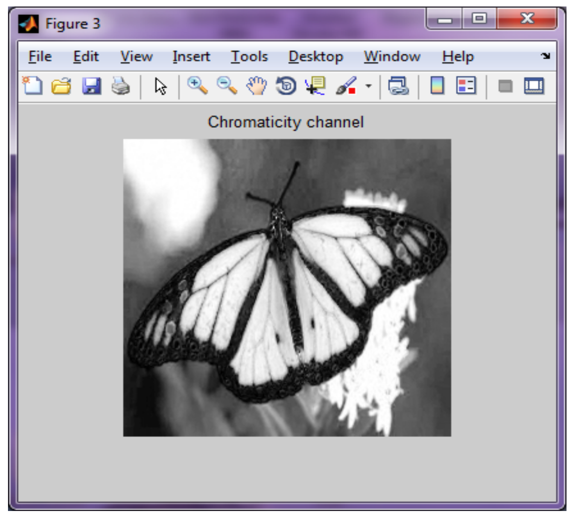

Fig. 2(e) Extracted chrominance channel

After extracting luminance channel, conventional JPEG compression method is applied on luminance channel.

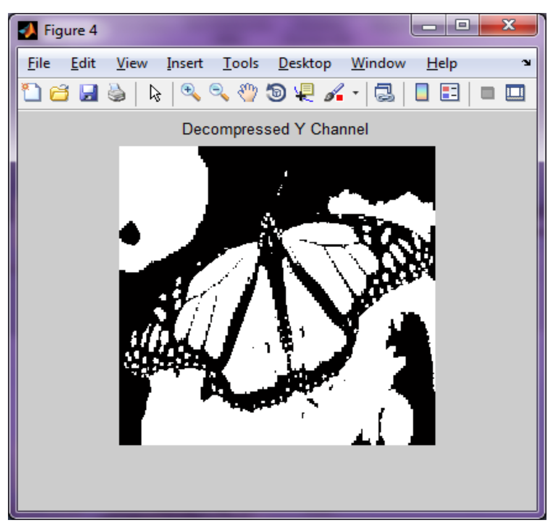

Fig. 2(f) Decompressed Luminance channel

Multiscale mean shift segmentation with different scales is applied. Following figures show output of Multiscale mean shift segmentation with scale values 1,5 and 8.

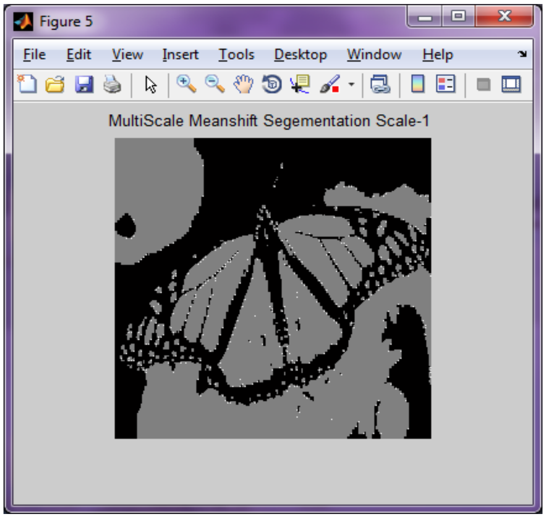

Fig.2(g) Meanshift Segmentation with scale 1

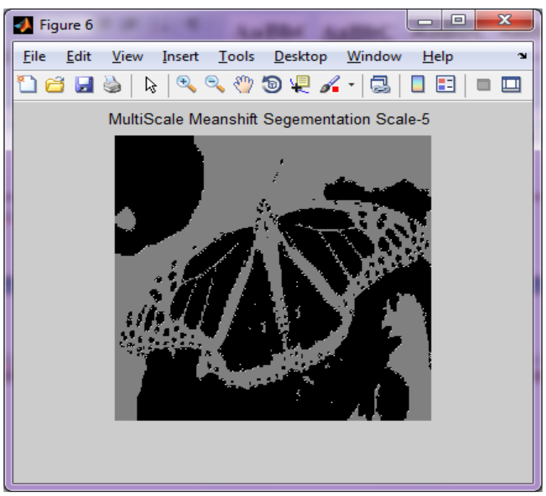

Fig.2(h) Meanshift Segmentation with scale 5

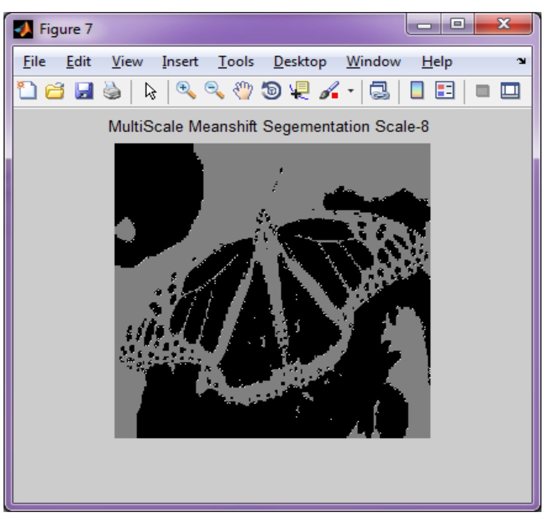

Fig. 2(i) Meanshift segmentation with scale 8

In figure 2(a)original color images is given as input to encoder model, after that first luminance channel is extracted from color image. After extracting luminance channel, conventional JPEG compression method applied on luminance Y channel. Figure 2(f) is showing output of decompression on compression Y channel data. After applying conventional JPEG compression method, multi scale meanshift segmentation method with scale values 1, 5 and 8 are applied as showing in above figures 2(g), 2(h) and 2(i) respectively. At encoder end, once meanshift segmentation results comes, further construction of colorization matrix is done and extracted RP set is given as an input to decoder model. Below are results achieved at decoder end for reconstruction of the same pepper image.

B. Results of Decoder Model

As per the block diagram given for implemented model, first compressed luminance Y channel is extracted from the coefficients received from encoder. After that multi scale mean shift segmentation is applied with different scales such as 1, 5 and 8 same as done encoder section. For results please refer above results in 5.3 to 5.6. After that construction of colorization matrix is done and then colorization is applied to reconstruct the original color image. Below figure shows, the result of image reconstruction is given for implemented method.

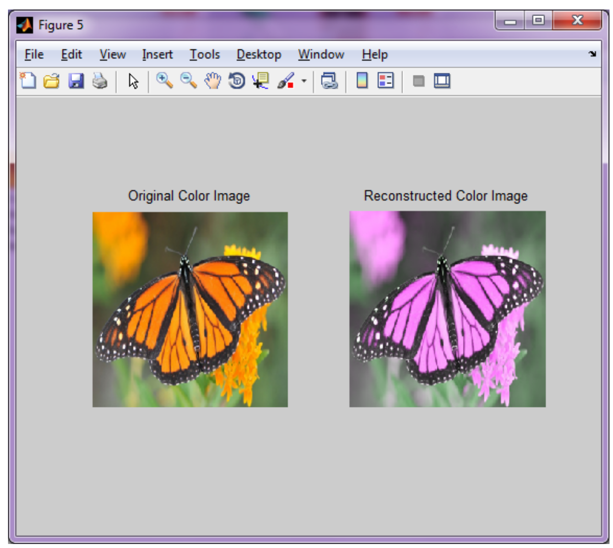

Figure 2(j): Reconstruction result at decoder end

Various color images are taken as an input to the implemented system. For that various performance parameters such as PSNR, SSIM and execution time are measured. These performance parameters are compared against performance parameters obtained by different methods. The results obtained are graphically represented. Following figures show the graphical results obtained

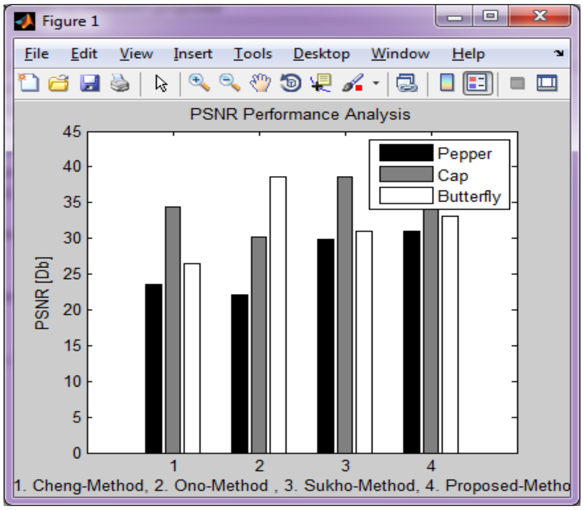

Fig.3(a) PSNR performance analysis for different input images & methods

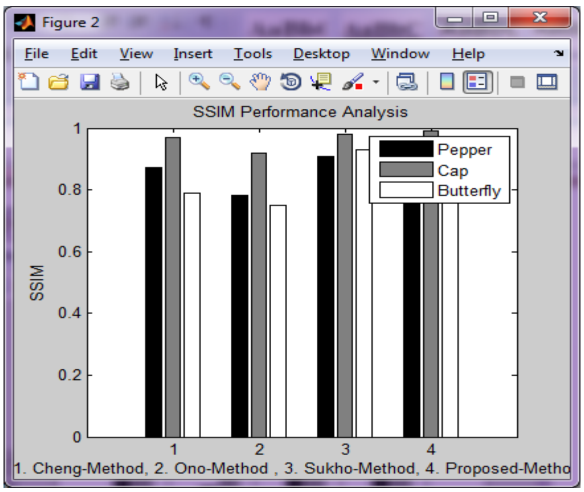

Fig.3(b) SSIM performance analysis for different input images & methods

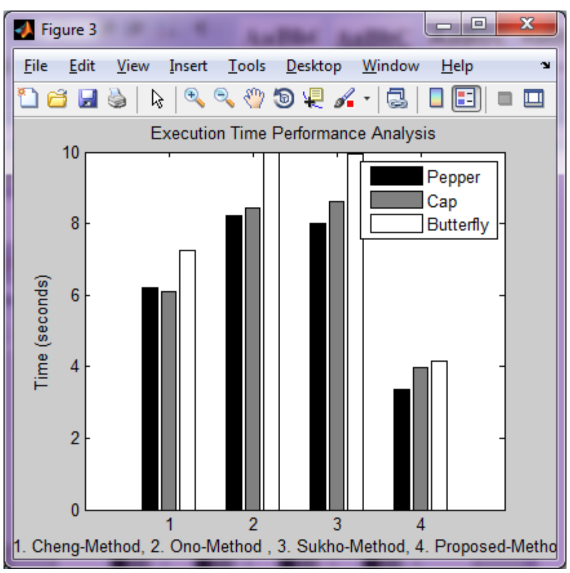

Fig. 3(c) Execution time Analysis for different input images & methods

we present comparative analysis of existing and implemented method in terms of below listed performance metrics

PSNR: The term peak signal-to-noise ratio (PSNR) is an expression for the ratio between the maximum possible value (power) of a signal and the power of distorting noise that affects the quality of its representation.

SSIM: The structural similarity (SSIM) index is a method for measuring the similarity between two images.

Execution Time: This metrics is used to claim that use of parallelism concepts can reduce the compression time and cost.

TABLE I: Comparative Study of PSNR

Image Name	JPEG2000 Method	Implemented Method
Pepper	27.87	31.05
Butterfly	25.78	31.77
Cap	30.07	33.12

TABLE II: Comparative Study of SSIM

Image Name	JPEG2000 Method	Implemented Method
Pepper	0.7534	0.8320
Butterfly	0.7422	0.8073
Cap	0.8004	0.9102

TABLE III: Comparative Study of Execution Time

Image Name	Implemented without Parallelism	Implemented with Parallelism
Pepper	8.02	3.35
Butterfly	9.94	4.15
Cap	8.6	3.99

From above comparative tables for PSNR, SSIM and execution time, it is clear that implemented method outperforming existing methods and improving efficiency for colour image compression.

IV. CONCLUSION

In this project, we formulate the colorization-based coding problem into an optimization problem. In colorization-based coding method, at the encoder we have chosen few representative pixels (RP) for the chrominance values and the RP set and compressed luminance information are sent to the decoder, and at the decoder end, the chrominance values for all the pixels are reconstructed by using colorization method. After that to reduce the computation time, we have used the parallelism concept which greatly reduces the total execution time and hence memory requirements. Experimental results show that the implemented method exceeds other colorization based coding methods to a large extent in quantitative as well as qualitative measures and gives comparative results even when lesser size image is transmitted. The memory requirement of the method increases with increase in segment size and hence the colorization matrix size. So better segmentation technique may be used in future which may be reduce colorization matrix size at the same time extracts optimal RP set.

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