ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

Improvement and Enhancement of Contrast for JPEG Images in the Compressed Domain

V V Susmitha[1],B.Suresh[2],B.RamaRao[3]
PG Scholar[1] , Associate Professor[2,3]
Department of Electronics and Communication Engineering
Amrita Sai Institute of Science and Technology
Paritala, Kanchikacherla, Krishna District , Andhra Pradesh , India

ABSTRACT

With the increase in digitization, there has been a great demand for data storage with effective techniques for data computation. As these days, a lot of data is being transferred over internet in the form of images, data storage is a prime concern, for which there is a requirement of image compression without losing the important details of the image. Digital image compression finds its applications in various fields like Medical, Automation, Defense, Photography etc. which also requires that the image produced should be visibly pleasing with sharp and clear details. The latter is achieved by a pre-processing technique called Image Enhancement.This research project is based upon the contrast enhancement of the color Images, where each color R-G-B channel is separately analyzed in the Y-Cb-Cr channel, in the compressed domain. The Discrete Cosine Transform is used as the compressed domain and further analysis is made on the block coefficients of the DCT where the block size considered is 8x8. Each DCT block contains one DC coefficient and 63 AC coefficients. The DCT coefficients are analyzed on the basis of their statistical behaviour. It is seen that the DC coefficient of each block DCT follow Gaussian distribution and the AC coefficients follow the Laplacian distribution .The DC coefficient being the mean value of the block DCT, is observed to be affecting the illumination of the image whereas the remaining 63 coefficients i.e. AC coefficients of the block DCT affected the contrast of the image. This thesis investigates a novel method for enhancing the image contrast based on the statistical behaviour of the block DCT coefficients. Furthermore, we use the concept of coefficient of variation (Cv) for arriving at a DC scaling factor required to modify the original DC coefficient value of each block. We also evaluate AC scaling factor by band analysis of each block based upon their contrast and entropy bands. The proposed work analyses both the DC coefficient and the 63 AC coefficients of each block separately.

Keywords: Discrete Cosine Transform; JPEG; Entropy; Contrast; Coefficient of Variation

I.INTRODUCTION

Image enhancement has always been a primary goal for image restoration in order to improve the image quality. It has been the process of improving the brightness, contrast and color of an image at the pre-processing, depending upon the application for better visual quality and rendering. A raw image data many a times requires to be processed before display. It may be that the dynamic range of the image is too large as compared to the bit-planes of the display equipment, presence of strong illumination in the background, insufficient lighting and many more. The complication arises when the scene illumination varies widely. In

ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

the aforementioned case, few regions of the image appear to be bright whereas few regions appear to be dark. As an example, in fig 1.1(a),where due to the bright sky, the details of the reflection on the glass window of the car are visibly unclear. Thus it requires improvement in the local contrast of the image .The image after being processed ,with improvement in display is shown in fig 1.1(b).

Figure 1&2 Shows: Original Image and Proposed Method

Image enhancement is very often used for improving the contrast of the images as it deals with the sharpness of the details in an image. Such methods are designed by locally varying the color intensity of an image, to produce a visibly sharp image. This task can be carried out either using the pixels of the image also referred to as spatial domain or in the frequency domain also termed as transform domain. Each domain has its own pros and cons. The spatial domain method for image enhancement provides better picture quality but there is a lot of computational complexity as it works on each pixel of the image. On the other side ,the compressed domain offers less storage space and computations are faster and easier to interpret.

II. PROPOSED METHOD

Most of the data nowadays are shared with the help of images over internet ,so in order to maintain the subjective quality of the images ,image enhancement is used as the pre-processing tool. As discussed before, Contrast and brightness of the image are two vital properties of an image that describe the image in terms of its quality. It is the Contrast of the image that helps in distinguishing one object over the other in an image. This research aims to analyze the following practical issues :

(a) Spatial domain [1, 2] and compressed domain [1, 3–7],methods offer various advantages and disadvantages. Since, the data size i.e image size is increasing these days there is a requirement of a method that is computationally effective and helps in providing less storage space .

(b) The increase in the usage of smart phones and new social networks like Facebook, Whatsapp, Twitter etc., there is a demand for storing images in compressed form without compromising for the image quality.

(c) Image compression degrades the quality of the enhanced image as compared to the image enhanced in the spatial domain due to the presence of artifacts while compression of data(image).

ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

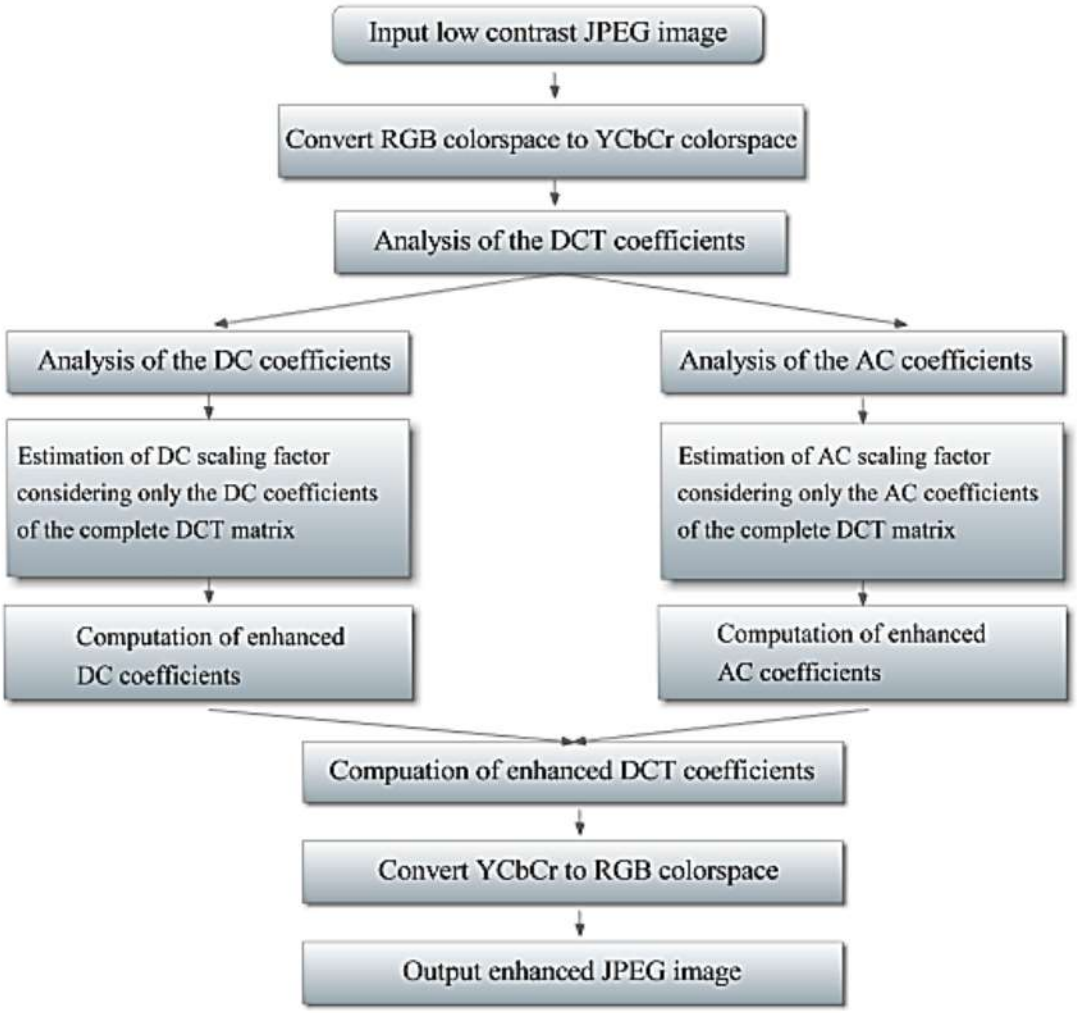

Figure 3: Shows Proposed Method Block Diagram

Figure.3 represents the flowchart of the proposed method. The proposed method takes into consideration the statistical behaviour of the Discrete Cosine Transform (DCT) coefficients that are extracted from the input image which is in the JPEG format[10]. This statistical behaviour of the DCT coefficients[11] is considered because the DC coefficient and the AC coefficients have different statistical distribution. The DC coefficient follow Gaussian distribution whereas the 63 AC coefficients of a block follow Laplacian distribution due to which they are analyzed separately . The proposed method utilizes this fact and evaluates scaling factors for each DC coefficient and AC coefficients. The scaling factors computed are then used to evaluate the enhanced DCT coefficients. The enhanced DCT coefficients produce better results quantitatively and qualitatively in comparison with the existing state-of-the-art technique i.e. Contrast Enhancement by Scaling(CES)[5].

III. RESULTS AND DISCUSSION

The proposed work is implemented using Matlab R2019a. The method is tested for the images which have been previously used for the studies related to image enhancement. The proposed method is also tested for the images provided in the UCID v2[14] dataset. The method is compared with a standard technique i.e. Contrast Enhancement by

ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

Scaling(CES)[5] , as the proposed method is motivated from the same. As discussed earlier, in the proposed method the DC coefficient and the AC coefficients of each block are treated separately in order to obtain different scaling factors one each for DC coefficient and AC coefficients. The different scaling factors that are obtained by treating the DC coefficient and the AC coefficients separately are thus independent of any pre-defined functions like twicing function, S-function etc. as used in CES[5]. These factors are then used further for modifying the DCT coefficients in order to obtain a better contrast and enhanced image. The proposed method offers various advantages over other enhancement techniques as discussed in detail in the following sections. The results obtained through the proposed method are presented qualitatively as well as quantitatively and are compared with CES method[5] ,for the validating the effectiveness of the proposed method.

Table 1: Shows Contrast Enhancement Factor (CEF) Evaluation

IMAGE NAME	CES[1] method	Proposed method
Image16	1.38	1.50
Image22	1.72	1.92
Image24	1.76	1.93
Ucid00196	1.46	1.69
Ucid00018	1.02	1.30
Ucid00095	1.40	1.78
Ucid00146	1.73	1.97
Ucid00470	1.42	1.76
Ucid00503	1.37	1.57
Ucid00564	1.38	1.49
Ucid00607	1.42	1.50
Ucid00609	1.58	1.86
Ucid00030	1.18	1.70
Ucid00155	1.74	1.92
Ucid01194	1.59	1.87

As seen from Table 1, the proposed method achieves much better CEF values as compared to the CES method[5]. The CEF values are observed for all the images taken from the CES work[5] and the UCID dataset[14]. This improvement in the measurement metric is made possible by considering the statistical behaviour of the DC coefficient and AC coefficients of the DCT blocks individually for arriving at their respective scaling factors. Though, the CES method[5] also gives good results, still modifying both the DC coefficient and the AC coefficients with a single scaling factor with the use of few external functions, is unable to utilize the DCT block behaviour. The proposed method, on the other side, is though motivated from the CES method[5], but the method utilizes the statistical behaviour[13] of the individual coefficients i.e. DC coefficient and the AC coefficients of each block irrespective of any external function for arriving at different scaling factors for the DCT coefficients of each block.

Each block of the compressed form of the image is analyzed on the basis of the statistical behaviour of the DC coefficient and AC coefficients of each block as both the coefficients of a DCT block affect the image in a different manner i.e. the DC coefficient affect the illumination of the image and the AC coefficients affect the contrast of the image, as described in detail in the earlier sections. This difference in the behaviour of the DCT coefficients is the base of our study, thereby producing a better result for the performance metric i.e. Contrast Enhancement Factor (CEF) as that compared to the CES work[5]. This method removes the

ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

dependence of the DCT coefficients on the external functions and analyses the behaviour of each coefficient of a DCT block in detail. This helps in the producing visually pleasing and sharp contrast images. The proposed method has helped in producing images with better subjective quality as compared to the CES method[5].

Figure 4:Shows Enhanced images using proposed method (a)original Image24 (b)Enhanced Image24 (c)original Ucid00155 (d)Enhanced Ucid00155 (e)Original ucid00196 (f)Enhanced ucid00196

V. CONCLUSION AND FUTURE SCOPE

The proposed algorithm is investigated to achieve a novel method for image enhancement for the JPEG compressed images. Experimental observations show better performance of the proposed algorithm as compared to an existing technique for image enhancement i.e. CES method[5].The research study utilized the statistical behaviour of the DC coefficient and the AC coefficients of each DCT block of the image in order to determine the different scaling factors for each i.e. the DC coefficient and the AC coefficients. Prior to finding a method for finding the scaling factors for the DCT coefficients, a study is carried on the statistical behaviour of the block DCT coefficients. It was found that the DC coefficient of each block when collected together tend to follow a Gaussian probability distribution function whereas the AC coefficients of each DCT block tend to follow the Laplacian probability distribution function[13]. As the DC coefficients of each block contain the average value of that block and it is observed that the variation of the DC coefficient they are analyzed in terms of their coefficient of variation(Cv) also known to be relative standard deviation.

ISSN: 2582 - 6379
Orange Publications
International Journal for Interdisciplinary Sciences and Engineering Applications
IJISEA - An International Peer- Reviewed Journal
2021,Sep, Volume 2 Issue 3
www.ijisea.org

The coefficient of variation (Cv) gives an idea about the deviation of the DC coefficient of each with respect to each other and this is utilized further in our study for arriving at the scaling factor for the DC coefficient of each block. On the contrary, the AC coefficients of each block are analyzed different to the DC coefficient. As the AC coefficient are found to be responsible for the contrast of an image, a multi-scale contrast [7] is utilized for its analysis, which is further used for analyzing the measure of information content using the multi-scale structure[7]. This helps in finding thestructure scaling factor for the AC coefficients of a DCT block. The DC scaling factor is same for all the blocks whereas the AC scaling factor varies from block to block. In both the cases, the proposed algorithm utilizes the statistical properties of the DCT coefficients to arrive at their respective scaling factors. The algorithm works upon the DCT coefficients and is independent of use of any external functions as utilized in the CES work[5].

SCOPE FOR FURTHER RESEARCH

The proposed work treats the DCT coefficients based upon their varied statistical behaviour and the DC coefficient and AC coefficients are scaled differently for each DCT block thereby producing better results subjectively and quantitatively than CES[5]. Though the algorithm has shown better results to CES[5] yet there are a few limitations to the proposed study. As the study is based upon the analysis of individual bands of each DCT block, the computation time taken for obtaining the scaling factor for AC coefficients of each block is higher. As the DC coefficient and AC coefficients are scaled by different factors for different blocks, there exist blocking artefacts in few cases which should be removed for obtaining a much better image.

REFERENCES:

[1] T. Celik, “Spatial entropy-based global and local image contrast enhancement,” IEEE Transactions on Image Processing, vol. 23, no. 12, pp. 5298–5308, dec 2014.

[2] J. Jiang and G. Feng, “The spatial relationship of dct coefficients between a block and its sub-blocks,” IEEE Transactions on Signal Processing, vol. 50, no. 5, pp. 1160–1169, may 2002.

[3] Z.-u. R. D. Jobson and G. Woodell, “Properties and performance of a center/surround retinex,” IEEE Transactions on Image Processing, vol. 6, no. 3, pp. 451–462, mar 1997.

[4] J. K. J. Tang and E. Peli, “Image enhancement in the jpeg domain for people with vision impairment,” IEEE Transactions on Biomedical Engineering, vol. 51, no. 11, pp. 2013–2023, nov 2004.

[5] J. Mukherjee and S. Mitra, “Enhancement of color images by scaling the dct coefficients,” IEEE Transactions on Image Processing, vol. 17, no. 10, pp. 1783–1794, oct 2008.

[6] S. Lee, “An efficient content-based image enhancement in the compressed domain using retinex theory,” IEEE Transactions on Circuits and Systems for Video Technology, vol. 17, no. 2, pp. 199–213, feb 2007.

[7] E. P. J. Tang and S. Acton, “Image enhancement using a contrast measure in the compressed domain,” IEEE Signal Processing Letters, vol. 10, no. 10, pp. 289–292, oct 2003.

[8] R. C. Gonzales and E. Woods, Digital Image Processing. Reading,MA: Addison-Wesley, 1992.

[9] S. Aghagolzadeh and O. K. Ersoy, “Transform image enhancement,” Optical Engineering, vol. 31, no. 3, pp. 614–626, 1992.

[10] S. J. Sangwine and R. E. N. Horne, The Colour Image Processing Handbook. Horne, Eds. London, U.K.: Chapman & Hall, 1998.

[11] E. Lam and J. Goodman, "A mathematical analysis of the dct coefficient distributions for images," IEEE Transactions on Image Processing, vol. 9, no. 10, pp. 1661–1666, oct 2000.

[12] F. Muller, "Distribution shape of two-dimensional dct coefficients of natural images," Electronics Letters, vol. 29, no. 22, pp. 1935–1936, oct 1993.

[13] R. Reininger and J. Gibson, "Distributions of the two-dimensional dct coefficients for images," IEEE Transactions on Communications, vol. 31, no. 6, pp. 835–839, jun 1983.

[14] G. Schaefer and M. Stich, "in proc. spie," in Ucid: an uncompressed color image database, vol. 5307, 2003, pp. 472–480.

[15] C.-R. C. W.-M. Ke and C.-T. Chiu, "Bita/swce: Image enhancement with bilateral tone adjustment and saliency weighted contrast enhancement," IEEE Transactions on Circuits and Systems for Video Technology, vol. 21, no. 3, pp. 360–364, mar 2011.

[16] H. Cheng and H. Xu, "A novel fuzzy logic approach to contrast enhancement," Pattern Recognition, vol. 33, no. 5, pp. 809–819, 2000