Combination of Brightness Preserving Bi-Histogram Equalization and Discrete Wavelet Transform using LUV Color Space for Image Enhancement

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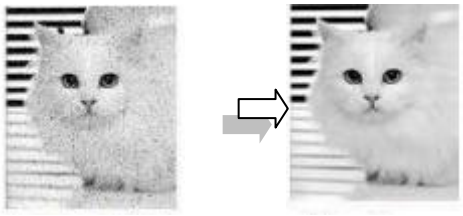
ABSTRACT
Image enhancement is the process of enhancing the image from the poor quality image to a visually pleasing image. The basic purpose of using image enhancement technique is to enhance the quality of the image. Image enhancement performs contrast enhancement and intensity transformations of the original image. Image enhancement is performed to obtain the image from the noising image so that it can be processed in future and can be used for further processing. At the time of acquisition, image can be corrupted or the contrast of the image may not retain its originality or due to the entrance of the noise. Thus to use this image for further processing it must be human viewing. Therefore, techniques are used for the enhancement of the image for years. Conventional image enhancement techniques do not obtain the quality oriented for specific applications. As a result, new technique is created in this paper which is based upon Brightness Preserving Bi-Histogram Equalization (BBHE) and Discrete Wavelet Transform (DWT) having LUV color space that produce good contrast images having less noise and blurriness.

Keywords
Image Enhancement, High Equalization, BBHE equalization, LUV color Space, DWT, Multilevel Enhancement

1. INTRODUCTION
Image enhancement is a technique that is used to enhance the contrast of the image which has been lost at the time of acquisition. Image enhancement is the part of digital image processing. [3] Reduction of noise, blurriness, increases the contrast of the image and revealing the details are the features of image enhancement technique. Image processing is the crucial part in Digital Image Processing technique. Image enhancement technique produces high quality image from the low quality image. [7] This technique focuses on enhancing the contrast of the image. Contrast is the ratio between the brightest and the darkest pixel intensity. Thus, to retain the contrast of the image and reveals the hidden parameters of the image are focusing part in the enhancement techniques.

Fig 1: Shows the basic working of image enhancement technique

It is being used for several years to enhance the quality of the image. Traditional techniques are not able to capture the high quality background image with the same intensity.[5] Thus, the proposed techniques have come into considerations to embed the dark images with the dark areas of the image having same intensity. In the traditional approaches, some of the areas have been lost due to the dark background and in the dark background, some areas are also dark that are unable to capture. Due to these reasons, proposed techniques are used.



Distorted image Enhanced image[7]

Fig 2: Image Enhancement

Image enhancement has been used in various fields for different purposes. For example, in the fingerprint recognition technique to recognize the person whether the person that is requesting for the access is authorized or not and in such case if the image is not visible enough then it may harm the security of the system. Therefore, the basic idea behind enhancement is to access the image for future reference such as segmentation, detection or recognition as well as for analysis purposes.[7]

As a result, image enhancement technique helps in obtaining the high quality image from the low quality image without the degradation of source. [13] It also aids in sharpening the details as well as reveals the important features of the image. Some of the techniques are simple while some of them are complex; whereas some techniques cannot enhance all the parts of the image.

2. IMAGE ENHANCEMENT TECHNIQUES
Image enhancement is done through different techniques. These techniques have their own pros and cons. According to the type of the image and enhancement requirements different techniques are applied onto the image to produce the quality oriented image. Image enhancement techniques are broadly classified into two categories:-

- Spatial based Domain techniques
- Frequency based Domain techniques

Spatial Based Domain Techniques
This technique works in terms of pixels or with the help of pixels. It can be expressed in the equation as:

$$G(x, y) = T[f(x, y)]$$

Where G(x, y) is the obtained image or the output image,

F (x, y) is the original image and T is an operator on f.

Spatial based domain technique performs calculation on the pixels to generate the image.[3] Histogram Equalization (HE), Logarithmic transforms technique comes under this technique. This technique works on a whole image due to which it produces undesirable results.

Frequency Based Domain Techniques
This technique is based on the mathematical functions or signals. It enhances the result in terms of frequency.[4] In this technique processing has been performed on the original image and then DWT applied and then inverse Fourier transform performs to produces the output image. [3]

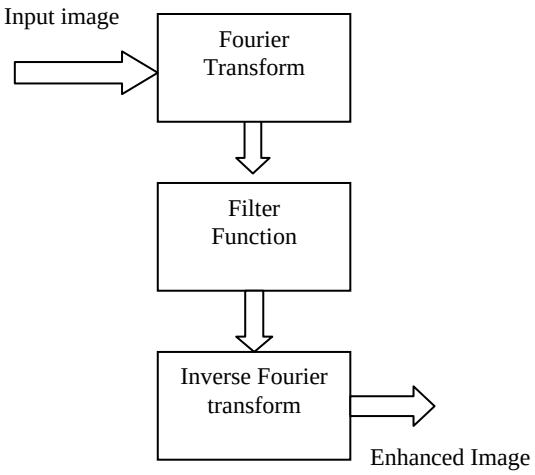


Fig 3: Working of Frequency based domain technique

3. CONVENTIONAL APPROACH

In the conventional approch, different techniques was used to enhance the quality of the image. But these techniques are not capable enough in producing good contrast images. Coventional DWT technique produces decent images but not able to generate high quality images in case of high contrast area. traditional techniques do not provide efficiency, accuracy as well as quality. [6] At the time of digitization, most of the data has been lost in the conventional approches. Due to these reasons, proposed approches are given. These techniques are helpful in obtaining the high contrast images even the image having dark intesity values can also be propoerly obtained.

4. PROPOSED WORK

To overcome the problems occurs in the traditional approaches, proposed techniques are used. In this paper, the proposed technique is used named BBHE i.e. Brightness Preserving Bi-Histogram Equalization and HE i.e. Histogram Equalization. In the proposed work, first LUV color space is applied to the original image, and then DWT Fourier transformation has been performed on the output image. After the application of the DWT-BBHE, HE equalization enhancement techniques are used to produce the enhanced image. After this process, inverse of DWT is performed to restore the image.

Histogram Equalization (HE)
It is the graphical representation of the image. It shows the results in the form of graphs. HE is the simple and easy to applicable technique. This technique produces the high quality image with efficiency as well as accuracy.[11]

Probability density function defined as:

$P(X_k) = n_k / n$ Where X_k is the given image and K varies from 0 to L-1, n_k represents the number of times that the level X_k appears in the input image X. n is the total number of samples.

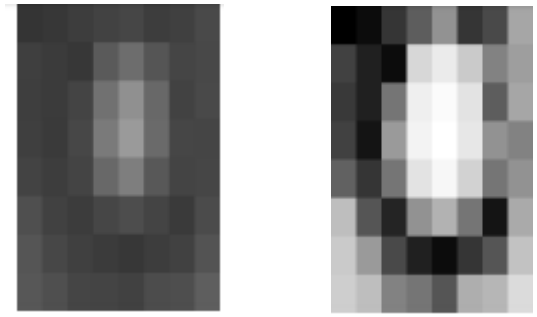


Fig 4: Shows the results of Histogram equalization [11]

In this paper, results have been performed to show the comparison between the conventional and the proposed technique. This paper concludes that the proposed technique is better than other techniques in terms of dynamic range of contrast, quality with proper intensity values.

5. METHODOLOGY

The image enhancement is done in order to improve the quality of the image .In this new hybrid approach is proposed in which the image equalization is done by combing two techniques i.e. DWT and BBHE. Following is the methodology of the work proposed.

1. Initially select the image from the image set given, the enhancements performed on the selected image to increase the quality of the image.
2. After selecting the image from the data set, convert the RGB image into the LUV color space and further processing is done on the image
3. Firstly apply the DWT technique on the image that is converted into LUV color space format.
4. After applying the DWT, next step is to apply the Brightness Preserving Bi-Histogram Equalization (BBHE) technique, so that the brightness of the imaged is increased equally.
5. Now apply IDWT in the image that is enhanced in order to get the original image .after applying IDWT now again convert LUV color space image into eth RGB image. The original image is again obtained.
6. Finally the enhanced image is obtained that is better than the original image, and the feature of the image is easily extracted and is more clearly visible and the calculation of the results is done.

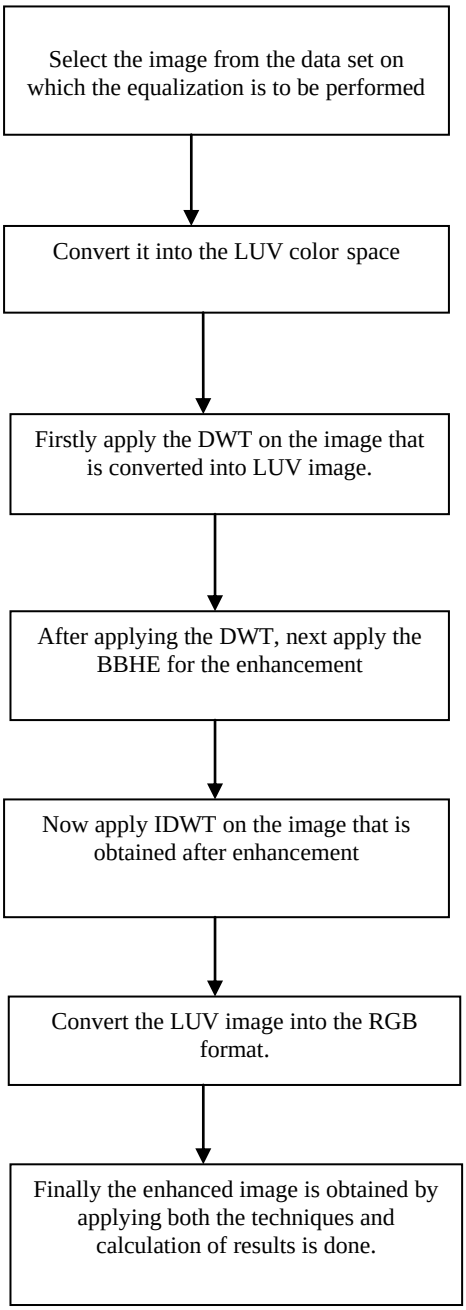


Fig 5: Shows the basic block diagram of proposed technique.

6. RESULTS AND DISCUSSION

In this section of the paper, proposed technique has been evaluated and shows the performance. It has proven the facts given before and concludes that proposed technique is better than the traditional one. Several parameters like PSNR ratio, Mean absolute error, noise estimation and local entropy increment has been used to enhance the quality of the image. Existing technique does not provide better output or enhanced quality due to which proposed approach has been used for the enhancement of the image.

Base of the proposed technique is DWT which was used in existing approach later on BBHE has applied on the image for better image quality and to overcome the problem occurs in the existing approach or alone DWT.

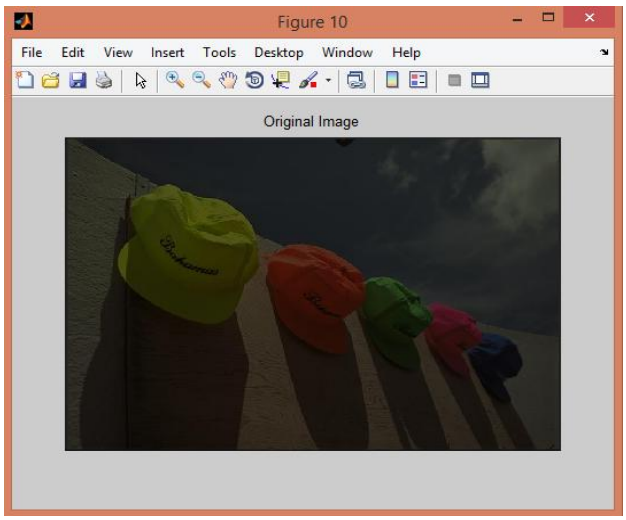


Fig 6: Original image for the valuation of proposed approach

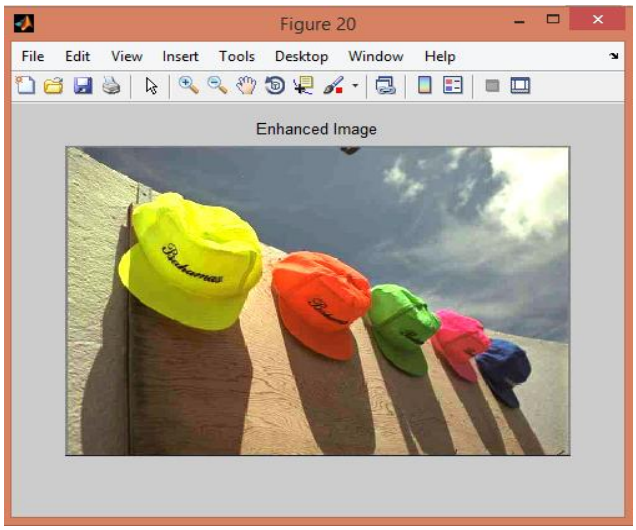


Fig 7: Shows the original image after the enhancement of the image through proposed approach

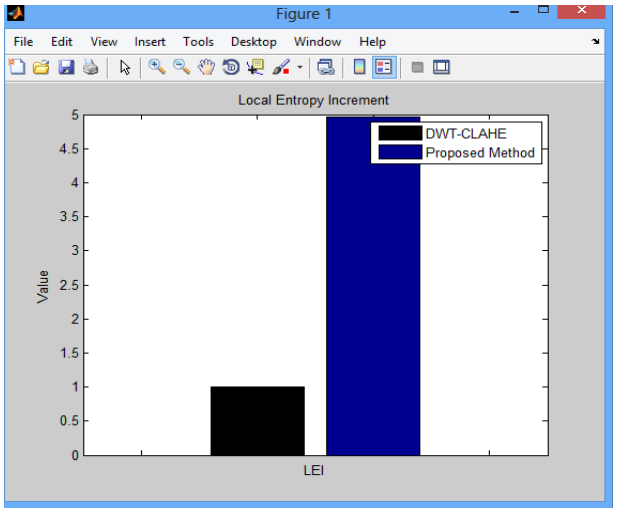


Fig 8: Comparison between the existing and the proposed technique based on Local Entropy Increment.

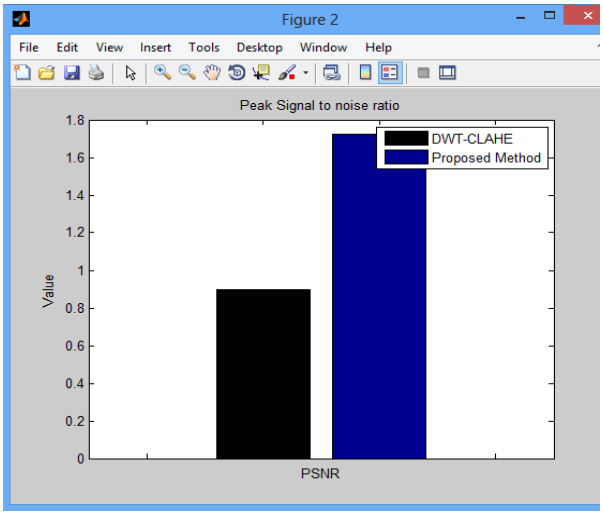


Fig 9: Shows PSNR ratio parameter comparison on the basis of DWT and Proposed approach.

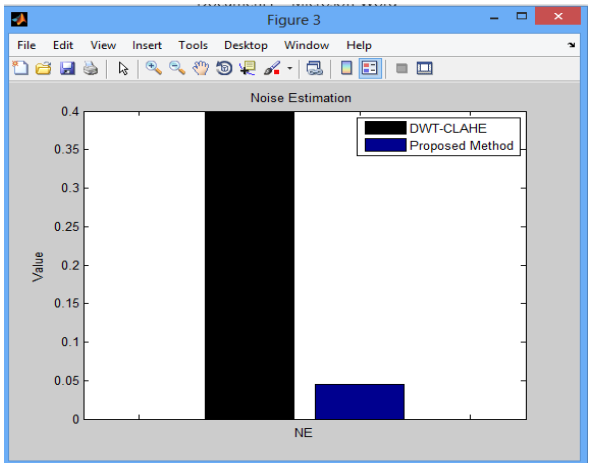


Fig 10: Noise estimation parameter has been used here to compare and contrast between traditional and given approach.

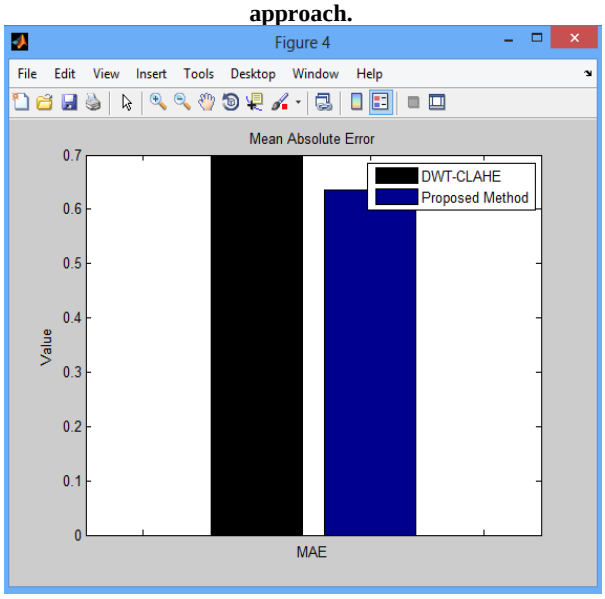


Fig 11: Comparison between the DWT and Proposed technique with the help of Mean Absolute Error.

7. CONCLUSION AND FUTURE SCOPE

Image can be distorted at the time of acquisition due to the access of noise. Accordingly to remove the noise from the image and improve the picture quality different techniques have been proposed till now. Existing technique do not able to obtain quality oriented image thus proposed technique has been obtained. In the proposed technique contrast is enhanced and by transforming intensity, image quality is improved.

Evaluations has been executed on the taken image, comparisons is done between the existing DWT and Proposed DWT which resultant into better performance and less noise. This paper presents LUV color space and BBHE for image enhancement. For the future reference, more advancement can be done in DWT technique to provide more enhanced image with less complexity and less noise as well.

8. REFERENCES

[1] S.S. Bedi et al, "Various Image Enhancement Techniques-Acritical Review", IJARCCE, Vol. 2, No. 3, Pp. 1605-1609, March 2013.

[2] Er. Mandeep Kaur et al, "Study of Image Enancement Techniques:A Review", IJARCSSE, Vol. 3, No. 4, Pp. 846-848, April 2013.

[3] Dr.Muna F. Al-Samaraie et al, "A New Enhancement Approch for Enhancing Image of Digital Cameras by Changing the Contrast" IJAST, Vol. 32, Pp. 13-22, July 2011.

[4] Ms. Seema Rajput et al, "Comparative Study of Image Enhancement Techniques", IJCSMC, Vol. 2, No. 1, Pp. 11-21, January 2013.

[5] Jinshan Tang et al, "Image Enhancement in the JPEG Domain for People With Vision Impairment", IEEE, Vol. 51, No. 11, Pp.2013-2023, November 2004.

[6] Tarun Mahashwari et al, "Image Enhancement using fuzzy technique", IJRREST, Vol. 2, No. 2, Pp. 1-4, June 2013.

[7] "Digital Image Processing for Image Enhancement and Information Extraction".

[8] Snehal O. Mundhada et al, "Image Enhancement and Its Various Techniques", IJARCS, Vol. 2, No. 4, Pp. 370-372, April 2012.

[9] Snehal O. Mundhada et al, "Image Enhancement using a Combined Approach of Spatial and Transformation Domain Techniques", IJERMT, Pp. 1-4, December 2012.

[10] Riccardo Poli et al, "Genetic Programming with User-Driven Selection: Experiments on the Evolution of Algorithms for Image Enhancement"

[11] Robert Hummel, "Image enhancement by histogram transformation", ELSEVIER, Vol. 6, No. 2, Pp. 184-195, April 1977.

[12] Yu Wang et al, "Image enhancement based on equal area dualistic sub-image histogram equalization method", IEEE Transactions on Consumer, Vol. 45, No. 1, Pp.68-75, August 2002.

[13] Huang Lidong et al, "Combination of contrast limited adaptive histogram equalisation and discrete wavelet transform for image enhancement", IEEE, Vol.9, No. 10, pp. 908-915, September 2015.

[14] J.B.Zimmerman et al, "An evaluation of the effectiveness of adaptive histogram equalization for contrast enhancement", IEEE Transactions on Medical Imaging, Vol. 7, No. 4, Pp. 304-312, December 1988.

[15] Sujan Rajbhandari et al, "Effective Denoising and Adaptive Equalization of Indoor Optical Wireless Channel With Artificial Light Using the Discrete Wavelet Transform and Artificial Neural Network", Journal of Lightwave Technology, Vol. 27, No. 20, Pp. 4493-4500, June 2009.

[16] Sos S. Agaian et al, "Transform Coefficient Histogram-Based Image Enhancement Algorithms Using Contrast Entropy", IEEE, Vol. 16, No. 3, Pp. 741-758, March 2007

[17] Shih-Chia Huang et al, "A New Hardware-Efficient Algorithm and Reconfigurable Architecture for Image Contrast Enhancement", IEEE, Vol. 23, No. 10, Pp.4426-4437, August 2014.

[18] G.j. Daniell et al, "Maximum entropy algorithm applied to image enhancement", Ieee, Vol. 127, No. 5, Pp. 170-172, September 1980.

[19] Y.C.Trivedi et al, "An experimental design approach to image enhancement", IEEE, Vol. 22, No. 4, Pp. 805-813, August 1992.

[20] R.Malladi et al, "A unified approach to noise removal, image enhancement, and shape recovery", IEEE, Vol. 5, No. 11, Pp. 1554-1568, November 1996.