



## A Review Paper on: Various Contrast Enrichment Techniques and Their Improved Factors

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**Abstract**— *The basic idea behind color and contrast enhancement in general is to provide a more alluring image or video by adjusting the amount of saturation and illumination to achieve more vibrant or realistic colors and to increase the visibility of details that may be obscured by deficient global and local lightness. We compared the performance of various color and contrast enhancement techniques using the parameters of lightness, chroma and hue. The comparative analysis includes three traditional methods, and a new proposed method has been approached as part of our research. Workings of these algorithms are compared with regard to the working requirements for an algorithm to be suitable for an image processing. We also reports the detailed results obtained from three traditional methods and proposed algorithm expected outcome. A number of still images and videos processing applications are use the various Methods to compare overall image/picture quality of various algorithm outputs. Expected results show a consistent adequate performance of the proposed algorithm, with prospects for further improvement.*

**Keywords**— *BBHE (Brightness Bi-Histogram Equalisation), MMBEBHE (Minimum Mean Brightness Error Bi-Histogram Equalisation), BPDHE (Brightness Preserving Dynamic Histogram Equalisation), GHE (Global Histogram Equalisation), DHE (Dynamic Histogram Equalisation), CLAHE (Contrast limited Adaptive Histogram Equalization), DSIHE (Dualistic Sub-Image Histogram Equalisation).*

### I. INTRODUCTION

Contrast enhancement of an image is an important challenge in the field of digital image processing. Contrast enhancement produces an image that subjectively looks better than the original image by changing the pixel intensities. These techniques find application in areas ranging from user electronics, Bio-medical image processing to aerospace image processing. Of the many techniques available for image contrast enhancement, the techniques that use first order statistics of digital images (image histogram) are very popular. Global Histogram Equalization (GHE) <sup>[1]</sup> is one such widely used technique. GHE is employed for its simplicity and good performance over variety of images. However, GHE introduces major changes in the image gray level when the spread of the histogram is not significant and cannot preserve the mean image-brightness which is critical to user electronics applications. To overcome this limitation, several brightness preserving histogram modification approaches, such as bi-histogram equalization (BBHE <sup>[2]</sup>, MMBEBHE <sup>[3]</sup>), multi-histogram equalization (DHE <sup>[4]</sup>, BPDHE <sup>[5]</sup>) and histogram specification (BPHEME) <sup>[6]</sup> have been proposed in literature. Dynamic Histogram Equalization (DHE)<sup>[4]</sup> method, proposed by Abdullah-Al-Wadud, et al., partitions the global image histogram into multiple segments based positions of local minima, and then independently equalizes them.

This technique claims of preserving the mean image brightness by this approach. However, this method has the limitation of remapping the peaks which leads to perceivable changes in mean image brightness. To avoid peak remapping, Ibrahim and Kong, in their Brightness Preserving Dynamic Histogram Equalization (BPDHE)<sup>[5]</sup> technique, use the concept of smoothing a global image histogram using Gaussian kernel followed by its segmentation of valley regions for their dynamic equalization. These techniques process the crisp histograms of images to enhance contrast. The crisp statistics of digital images suffers from the inherent limitation that it does not take into account the inexactness of gray-values. Additionally, crisp histograms need smoothing to achieve useful partitioning for equalization. Here we introduce a modification to BPDHE <sup>[5]</sup> technique with the use of fuzzy statistics of digital images (fuzzy histogram) <sup>[7]</sup>. Besides, the imprecision in gray levels is handled well by fuzzy measurement (set theory), fuzzy histogram, when computed with appropriate membership function of fuzzy logic, does not have random variations or undefined intensity levels and is relatively smooth. This aids in determining its meaningful splitting required for brightness preserving equalization. Experiments reveal that the use of fuzzy statistics has indeed improved performance of the algorithm.

### II. LITERATURE SURVEY

The main objective of image enhancement is to process the image so that the result is more suitable than the original image for a precise application. The word precise is important because a method useful for enhancing X-ray images may not necessarily be the best approach for enhancing the pictures of Mars transmitted through space. Image Enhancement is classified in two broad categories:

The term Spatial Domain refers to the image plane itself and the approaches in this category are based on direct improvement of pixels present in an image. Frequency Domain processing techniques depends on amending the Fourier transform of an image. Developments in microcontroller, DSP boards and computers have opened new prospects to digital image processing, and have opened many avenues to the design and implementation of new innovative techniques.

Fuzzy logic<sup>[8]</sup> has rapidly become one of the most successful of today's technologies for developing sophisticated control systems. The motive behind this is very simple. Fuzzy logic highlights most applications seamlessly as it resembles human decision making with an ability to generate accurate solutions from slight or approximate information. This contribute new horizon in engineering design methods which are not accomplished by purely mathematical approaches (e.g. linear control design), and purely logic-based approaches (e.g. expert systems) in system design. On the other hand<sup>[9]</sup>, many difficulties in image processing arise because the data/task/result is inexact. This ambiguity is not always due to the randomness but due to uncertainty and vagueness. Besides arbitrariness which can be managed by probability theory, there are other three types of uncertainty in image processing are as follows:

- Grayness Ambiguity
- Geometrical Fuzziness
- Uncertain Knowledge

#### **Previous Related Works:**

The question that may arise whether the pixel should become brighter or darker than it already is. These problems are fuzzy in nature. The question where the boundary between two segments, such and other similar questions are examples for situations where a fuzzy approach can be more appropriate to manage the uncertainties.

- **“Transform-Based Image Enhancement Algorithms with Performance Measure”** by Sos S. Aghaian, Karen Panetta and Artyom M. Grigoryan (*Member, IEEE 2001*)<sup>[10]</sup>, This paper introduces a new kind of “frequency domain” based signal/image enhancement algorithms (magnitude enrichment, log-magnitude reduction, iterative amplitude, and log-reduction zonal magnitude techniques) have been described and applied for detection and visualization on objects within an image. The new techniques are based on the so-called “sequency” ordered orthogonal transforms, which include the well-known fast orthogonal Fourier, Hartley, cosine, and Hadamard transforms, as well as new enhancement techniques. We have improved upon the current magnitude reduction techniques and developed an entirely novel method. The wide range of characteristics can be obtained from a single transform by varying enhancement parameters. A quantitative measure of signal/image enhancement was presented, which demonstrated the optimal method to automatically choose the best parameters and transform. The proposed technique is simple to design and implement, which makes them practical. A number of experimental results were given which illustrate the performance of these algorithms. The comparative analysis of transforms based image enhancement algorithms has been described, too. Lastly, the comparison of the Fourier transform and Walsh, cosine and Hartley transforms was given. We find that for a negligible trade-off of accuracy, one can use the Walsh transform to achieve significantly higher performance enhancement. For our purposes, where speed is a major concern, the proposed method turns out to be a dramatic improvement over existing methods. We have also proposed the zonal transform based image enhancement algorithms.
- **“A Comparative study of Image Enhancement using Histogram Approach”** by Krishan Kant Lavania Shivali Arya and Rajiv Kumar (2011). In this paper, the author analyzes two image enhancement techniques based on spatial domain approach. Histogram Equalization generates a gray map which changes the histogram of an image and redistributing all pixels values to be as close as possible to a user-specified preferred histogram. Histogram equalization allow for areas of lower local contrast to gain a higher contrast. In Histogram design, input image has given, and then the target histogram is specified, image has processed in such a way that the histogram of the processed image will be close to the target image. The author evaluated and compared these two methods based on their EME values. The experimental results show that Histogram Specification is better than Histogram Equalization because the images are more cleared and the background is more detailed.
- **“Adaptive Image Contrast Enhancement Using Generalizations of Histogram Equalization”** by J. Alex Stark (2000)<sup>[10]</sup>. This paper introduces a method for adaptive image contrast enhancement based on a generalization of histogram equalization (HE). HE is a useful technique for improving contrast of an image, but it is use for many purposes. However, severely different results can be obtained with relatively minor manipulations. A brief description of adaptive HE is set out, and this framework is used in a discussion of past suggestions for variations on HE. The prime key of this technique is a “cumulation function,” which is used to produce a grey level mapping from the local histogram. By selecting alternative forms of cumulation function one can experience a wide variety of effects. A precise form is proposed. Through the variation of two or three parameters, the results can produce a dynamic range of contrast enhancement, at one severe leaving the image unaffected, on the other hand yielding full adaptive equalization.
- **“Contrast Enhancement Using Brightness Preserving Bi-Histogram Equalization”** by YEONG-TAEKGI M (*MEMBER, IEEE, Signal Processing R&D Centre, Samsung Electronics Co., Suwon, Korea, 1997*). In this paper, a newly developed contrast enhancement algorithm referred to as the *Brightness preserving Bi-Histogram Equalization* (BBHE) is proposed. The BBHE is a novel extension of a typical histogram equalization, which uses independent

histogram equalizations over two sub images obtained by decomposing the input image based on its mean. The aim behind the BBHE is to maintain the mean brightness of a given image while enhancing the contrast of a given image. Analysis on the (output mean of the BBHE for a given analog image having symmetric distribution is also established mathematically, which indicates that the BBHE is capable of preserving the mean brightness of a given image. Simulation results also demonstrate the brightness-preserving function of the BBHE while enhancing contrasts. Hence, many applications can be made possible by utilizing the proposed algorithm in the field of consumer electronics, such as TV, VTR, or, camcorder. In the view point of H/W implementation, however, the proposed algorithm requires more complicated H/W than the typical histogram equalization. For effective use of the proposed algorithm in applications, an effort to reduce the complexity should be made such as the method introduced in <sup>[5]</sup> which makes use of quantized probability density functions.

- **“Image Enhancement Using a Contrast Measure in the Compressed Domain”** by Jinshan Tang, Eli Peli, and Scott Acton (*Senior Member, IEEE, 2003*). In this letter, we have described an image contrast enhancement algorithm that is based on a contrast measure defined in the DCT domain. The comparative analysis between the proposed algorithm and two existing algorithms has shown the merit of the contrast measure-based approach.
- **“Survey of Contrast Enhancement Techniques based on Histogram Equalization”** by Manpreet Kaur, Jasdeep Kaur, Jappreet Kaur (*2011*). In this paper, the comparative study of Histogram Equalization based methods shows that the cases which require higher brightness preservation and not improved well by HE, BBHE and DSIHE, have been accurately improved by RMSHE. MMBEBHE is the extension of BBHE method that provides maximal brightness preservation. Although these techniques can perform better contrast enhancement, these cause more infuriating side effects depending on the variation of gray level distribution in the histogram. DHE ensures uniformity in preserving image details and is free from any severe side effects. BPDHE can preserve the mean brightness better than BBHE, DSIHE, MMBEBHE, RMSHE, MBPHE, and DHE. MCBHE is simple and heuristic method for contrast enhancement in grayscale images and able to enhance the quality of images such that both global and local contrast is enhanced with minimum distortion in the image appearance. WMSHE achieves the best quality through qualitative visual inspection and quantitative accuracies of Peak Signal-to- Noise Ratio (*PSNR*) and Absolute Mean Brightness Error (*AMBE*) compared to other state-of-the-art methods.
- **“Histogram Equalization Techniques for Image Enhancement”** by Rajesh Garg, Bhawna Mittal, Sheetal Garg (*2011*). In this Paper, a frame work for image enhancement based on prior knowledge on the Histogram Equalization has been presented. Many image enhancement schemes like Contrast limited Adaptive Histogram Equalization (CLAHE), Equal area dualistic sub-image histogram equalization (DSIHE), Dynamic Histogram equalization (DHE) Algorithm has been implemented and compared. The Performance of all these Methods has been analysed and a number of Practical experiments of real time images have been presented. From the experimental results, it is found that all the three techniques yields Different aspects for different parameters. In future, for the enhancement purpose more images can be taken from the different application fields so that it becomes clearer that for which application which particular technique is better both for Gray Scale Images and color Images. Particularly, for color images there are not many performances measurement parameter considered. So, new parameters can be considered for the evaluation of enhancement techniques. New color models can also be chosen for better comparison purpose. Optimization of various enhancement techniques can be done to reduce computational complexity as much as possible.
- **“A Comparative Study of Color and Contrast Enhancement for Still Images and Consumer Video Applications”** by Abhijit Sarkar, Mark D Fairchild, Jorge Caviedes, Mahesh Subedar (*Munsell Color Science Laboratory, Rochester Institute of Technology, Rochester, NY (USA), Intel Corporation, Chandler, AZ (USA)*)<sup>[11]</sup>. The goal of color and contrast enhancement in general is to provide a more appealing image or video by adjusting the amount of saturation and lightness to achieve more vivid or realistic colors and to increase the visibility of details that may be obscured by deficient global and local lightness. We modified and compared the performance of various color and contrast enhancement algorithms using image difference maps in all three dimensions of brightness, chroma and hue, derived from IPT, a steady, perceptual color space. The comparative study includes four published methods, two proprietary algorithms commonly used in consumer video applications and a new proposed approach implemented as part of our research. Performances of these algorithms are evaluated with regard to the working necessities for an algorithm to be suitable for a typical video processing in consumer systems. We also report the results obtained from two psychophysical experiments involving the proprietary and proposed method. A number of still images and videos are used in the Method of Paired Comparison experiments to compare overall image/picture quality of various algorithm outputs. Expected results show a consistent satisfactory performance of the proposed algorithm, for further improvement.
- **“A Comparative Study on Image Enhancement Using Image Fusion”** by Er. Vinod Saini and Er. Tarun Gulati (*2012*)<sup>[12]</sup>. In this paper, Image enhancement is used for improving the visual quality of an image. In this paper two methods for image enhancement using image fusion have been defined. The methods of image fusion use a source image and its histogram equalized image. The above described two algorithms assigns weights to the source image and

its histogram equalized image. In the first algorithm weight is assigned manually whereas in the second algorithm it will get assigned them automatically. The two algorithms are compared using standard deviation and average gradient.

- **“Image Enhancement and Its Various Techniques”** by Snehaal O. Mundhada Prof. V. K. Shandilya (2012)<sup>[13]</sup>. In this paper, Most of the algorithms are useful for enhancing the gray level values of individual pixels and hence enhances the overall contrast of the entire image. But they usually improve the entire image in a identical manner which in many cases produces unwanted results. There are various techniques available which produce highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result.
- **“Comparative Study of Image Enhancement Techniques”** by Ms. Seema Rajput and Prof. S. R. Suralkar (2013)<sup>[14]</sup>. In this paper, Image enhancement is the improvement of digital image quality (wanted e.g. for visual inspection or for machine analysis), without information about the source of deprivation. Different image augmentation methods are compared by taking parameters Root Mean Square Error (RMSE), Peak Signal to Noise Ratio (PSNR), and Correlation Coefficient (CC), SSIM. This paper conclude that Use of the edge adaptive hybrid filter gives some better results compared to histogram processing, negative enhancement, contrast stretching, filtering, AWMF,EASF.

### III. SOFTWARE SIMULATION OF DESIGN

In order to work on Images with high definition scale there will be a need of understanding the aspect ratio of the image which can be dynamic in nature, so by using FUZZY tool from MATLAB, I will try to overcome such uncertainties.

#### (1) Image Contrast Enhancement Using Adaptive Histogram Equalization (Clahe) Method For Grayscale Image

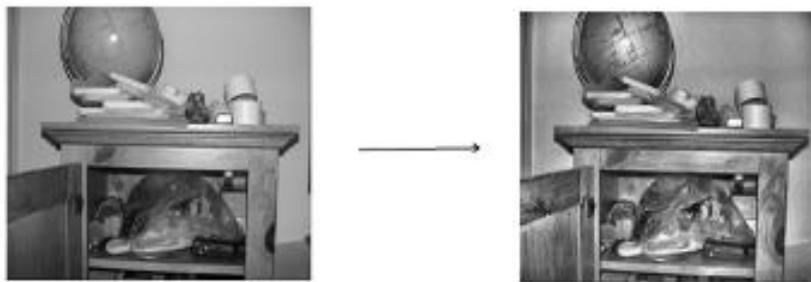


Fig. 1: Original Image and Output Image after applying AHE method

#### (2) Image Contrast Enhancement Using Histogram Equalization Method For Gray Image

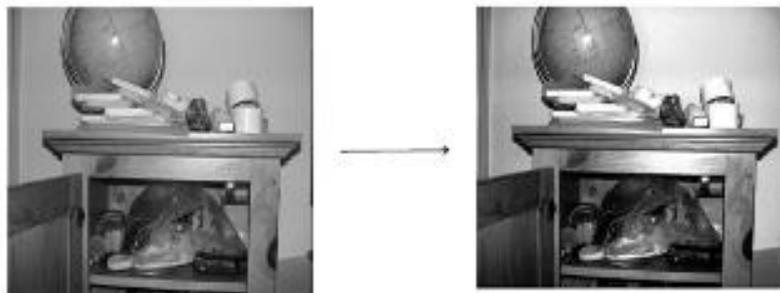


Fig. 2: Original Image and Output Image after applying HE method

#### (3) Image Contrast Enhancement Using Histogram Equalization Method For Color Image



Fig. 3: Original Image and Output Image after applying HE method

#### IV. PROPOSED PLAN OF WORK

##### **Brightness Preservation for Dynamic Histogram Equalization using FUZZY statistics:**

In GHE the remapping of the histogram peaks (local maxima) takes place which tends to the preamble of unwanted artifacts and large change in mean image brightness. The BPDFHE technique manipulates the image histogram in such a way that no remapping of the histogram peaks takes place, while only redistribution of the gray-level values in the valley portions between two consecutive peaks takes place. The BPDFHE technique comprise of following operational stages:

- A). Fuzzy Histogram Computation.
- B). Partitioning of the Histogram.
- C). Dynamic Histogram Equalization of the Partitions.
- D). Normalization of the image brightness.

##### **Contrast Enhancement of Color Images:**

Most electronic equipment's acquire and display color images. In this scenario, the technique of enhancing color images would be of better interest. Most of the classical approaches apply equalization of the red, green, and blue planes in the RGB images. However, this approach has an inherent problem of changing the hue of the output image. Thus, we perform the YCbCr color space, where we only equalize the intensity band of the image, while preserving the chromaticity of the image. This method produces better perceptible results as compared to equalizing the R, G, and B planes separately.

#### V. METHODOLOGY FOR IMPLEMENTATION

In recent years, the number and variety of applications of fuzzy logic have increased extensively. The applications vary from consumer products such as SLR's, DSLR's, washing machines, and conventional ovens to industrial process control, bio-medical instrumentation, decision-making systems, and assortment selection. To recognize why use of fuzzy logic has grown, we must first understand what is meant by fuzzy logic. Fuzzy logic has two unusual meaning. In a slight way, fuzzy logic is a logical system, which leads to an expansion of multi valued logic. However, considerably fuzzy logic (FL) is almost synonymous of the sets theory, a theory which relates to classes of substance with unsharp boundaries in which membership is a matter of degree. In this perception, fuzzy logic in its narrow sense is a branch of FL. Even though in its more narrow definition, fuzzy logic differs both in idea and matter from traditional multi valued logical systems. In the lack of precise mathematical model which will describe behaviour of the system, Fuzzy Logic Toolbox is a good "weapon" to solve the problem: it allows using *logic if-then rules* to describe the system's behaviour. This Toolbox is a compilation of functions built on the MATLAB® numeric computing environment and provides tools for creating and editing *fuzzy inference systems* within the framework of MATLAB. So a fuzzy tool with histogram equalization is being used. The toolbox provides three categories of tools:

- command line functions,
- graphical interactive tools and
- Simulink blocks and examples.

The Fuzzy Logic Toolbox provides a number of interactive tools that allow accessing many of the functions through a graphical user interface (GUI). Fuzzy Logic Toolbox allows building the two types of system:

- Fuzzy Inference System (FIS)
- Adaptive Neuro-Fuzzy Inference System (ANFIS)

#### VI. CONCLUSION OF REVIEW

Generally the bio-medical images needs to be in exact manner without loosing of information along with the enhanced and clear edges to pretend the information in the image very carefully so the proposed scheme can be able to enhance the image to a certain level as compared to the other algorithms.

#### REFERENCES

- [1] R.C.Gonzalez and R.E.Woods, Digital Image Processing, 2nd ed., Prentice Hall, 2002.
- [2] Y.T.Kim, "Contrast Enhancement Using Brightness Preserving Bi- Histogram Equalization", IEEE Trans., Consumer Electronics, vol. 43,no. 1, pp. 1-8, 1997.
- [3] S.D.Chen and A.R.Ramli, "Minimum Mean Brightness Error Bi- Histogram Equalization in Contrast Enhancement", IEEE Trans.,Consumer Electronics, vol. 49, no. 4, pp. 1310-1319, Nov. 2003.
- [4] J M. Abdullah-Al-Wadud, et al, "A Dynamic Histogram Equalization for Image Contrast Enhancement", IEEE Trans., Consumer Electronics, vol. 53, no. 2, pp. 593-600, May 2007.
- [5] H. Ibrahim, and N. S. P. Kong, "Brightness Preserving Dynamic Histogram Equalization for Image Contrast Enhancement", IEEE Trans.,Consumer Electronics, vol. 53, no. 4, pp. 1752-1758, Nov. 2007.
- [6] C. Wang and Z. Ye, "Brightness Preserving Histogram Equalization with Maximum Entropy: A Variational Perspective", IEEE Trans.,Consumer Electronics, vol. 51, no. 4, pp. 1326-1334, Nov. 2005.
- [7] C. V. Jawahar, and A. K. Ray, "Incorporation of gray-level imprecision in representation and processing of digital images", Pattern Recognition Letters, vol. 17, no.5, pp. 541-546, May 1996.
- [8] Milindkumar V.Sarode, Dr.S.A.Ladhake, Dr.Prashant R.Deshmukh, "Fuzzy system for color image enhancement", proceedings of world academy of science, engineering and technology volume 3,6 december 2008 issn 2070-3740

- [9] Aboul Ella Hassanien, Amr Badr, "A Comparative Study of Digital Mamography Enhancement Algorithms based on Fuzzy Logic".
- [10] J. Alex Stark "Adaptive Image Contrast Enhancement Using Generalizations of Histogram Equalization" IEEE transactions on image processing, vol. 9, no. 5, may 2000
- [11] Abhijit Sarkar, Mark D Fairchild, Jorge Caviedes, Mahesh Subedar "A Comparative Study of Color and Contrast Enhancement for Still Images and Consumer Video Applications". Munsell Color Science Laboratory, Rochester Institute of Technology, Rochester, NY (USA), Intel Corporation, Chandler, AZ (USA).
- [12] Er. Vinod Saini and Er. Tarun Gulati " A Comparative Study on Image Enhancement Using Image Fusion" International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 10, October 2012.
- [13] Snehal O. Mundhada and Prof. V. K. Shandilya "Image Enhancement and Its Various Techniques" International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 4, April 2012.
- [14] Ms. Seema Rajput and Prof.S.R.Suralkar "Comparative Study of Image Enhancement Techniques", International Journal of Computer Science and Mobile Computing, *IJCSMC*, Vol. 2, Issue. 1, January 2013.