International Journal of Scientific Research in Computer Science, Engineering and Information Technology
© 2017 IJSRCSEIT | Volume 2 | Issue 3 | ISSN : 2456-3307

# A Review on Image Enhancement Techniques

**Varsha, Manju Mathur**

Department of Electronics & Communication Engineering, Rajasthan College of Engineering for Women, Jaipur, Rajasthan, India

## ABSTRACT

This work is intended to analyse and study the techniques used for enhancing the quality and the detail of information content into the image file. Sometime due to bad light or high luminous images clicked by or captured by the devices may be categorized into two, either in overexposed or in underexposed category. To eliminate the irregularities of this type image enhancement algorithm may be used. The main purpose of image enhancement is to bring out feature that is hidden in an image increase contrast in a low contrast image, or to process an image so that outcome is more appropriate than inventive image. In this paper different techniques and issues have been discussed and a postulate has been made out of the review techniques.

**Keywords :** Luminous Images, Histogram Equalization, Image Enhancement, MMBEBHE, BBHE, DSIHE, DHE, DCT, DWT, ADPHE

## I. INTRODUCTION

Image enhancement is the procedure of renovating digital images so that the consequences are more appropriate for display. These methods have been widely used in many applications of image processing where the subjective quality of images is important for human construal. In any subjective evaluation of image excellence contrast is an important article. Contrast is created by the difference in luminance reflected from two adjacent surfaces. In other words, contrast is the difference in visual properties that makes an object distinguishable from other objects and the background. In graphical observation, contrast is decided by the change in the color and illumination of the object with other substances. Our visual system is more sensitive to contrast than absolute luminance; therefore, we can perceive the world similarly regardless of the considerable changes in illumination conditions. Many algorithms for accomplishing contrast enhancement have been developed and applied to difficulties in image processing.

An image can be described as a two dimensional function f(u,v),where u and v are spatial coordinates, and the amplitude of f at any combination of coordinates (u, v) is known as the intensity or gray level of the image at that focus. When u, v and the breadth values of f are all determinate, discrete measures, the image is called as a digital image. The arena of digital image processing denotes to deal with digital images by what means a digital computer. An image is made up of a limited digit of elements, each of which has a precise locus and assessment. These constituents are mentioned to as picture elements, image elements, pixels. Pixel is the word used commonly to signify the elements of a digital image.

## II. PREVIOUS WORK

Various image enhancement techniques that have been studied and developed so far are as follows:-

**Image Enhancement by Histogram Equalization:-**
A basic structure based on histogram equalization for image contrast enhancement is shown in various works [1-3]. In this structure, contrast enhancement is

postured as an optimization difficult that decreases a cost function. They presented precisely planned fine terms, the contrast enhancement level can be attuned; black or white broadening, noise robustness and mean-brightness preservation may easily be integrated into the development. Logical explanations for some important standards are represented along with a low-complexity algorithm for contrast enhancement was accessible, and its presentation was established against a newly proposed method.

These structures [4] pay sensibly planned consequence relations to alter the different sides of contrast augmentation. Hence, the contrast of the image/video can be improved without introducing (Figure 2) visual artifacts that minimize the visual quality of an image and cause it to have an abnormal look.

**Figure 1:-** Original Image

**Figure 2:-** Contrast Limited Adaptive Histogram Equalization

To achieve a real-time implementable algorithm, the proposed method avoids inconvenient calculations and memory-bandwidth containing tasks. Attained outcomes were visually agreeable, artifact free, and normal looking. The proposed algorithm attribute was that it does not familiarize noise, which is essential for video presentations. This is essentially because of that the planned method customs the input (conditional) histogram, which does not vary in an communicative mode within the same extract. Then, the proposed technique transforms it by means of linear operations resultant from dissimilar terms in the objective besides creating algorithmic hard decisions.

In 2004 [3] matter on Histogram equalization were examined and it was proposed that Histogram Equalization is modest still important image enhancement method. Though, it inclines to interchange the brightness of an image in an sensitive manner, causing irritating a unnatural and artifacts contrast enhancement. They estimated a exclusive scheming of BBHE referred to as MMBEBHE (minimum mean brightness error bi-histogram equalization). MMBEBHE has the attribute of decreasing the variance between input and output image's temperate. Reproduction to derive out displayed that MMBEBHE can preserve brightness better than BBHE and DSIHE. Additionally, this effort also bordered an important, integer-based execution of MMBEBHE. Nonetheless, MMBEBHE also has its limitation. There is also recommended generalization of BBHE referred to as RMSHE ( recursive mean-separate histogram equalization). RMSHE is presented with ascendable brightness preservation. Simulation outcomes viewed that RMSHE is the best equalization technique rather than HE, BBHE, DSIHE, and MMBEBHE. It has been detected that the effort in framework of bi-histogram equalization, MMBEBHE is better than BBHE and DSIHE in conserving an image's novel intensity.

**Figure 3.** Local Histogram Equalization

**Figure 4.** Global Histogram Equalization

In 2004 [3] it is discovered that image enhancement is one of the utmost major concerns in low-level image processing. In certain algorithm fundamentally enhancement methods were divided into two types: global and local methods. In such effort the multi-peak generalized histogram equalization is projected. The global Histogram equalization is upgraded by using multi-peak histogram equalization added with local info. These enhancement approaches are centered either on local information or on global information. Such approach used both global and local information to enhance image quality. This technique accepts the qualities of existing procedures. It also marks the grade of the enhancement totally manageable. Investigational outcomes express that it is very effective in enhancing images with low contrast, irresponsible of their brightness. Multi-peak Global Histogram Equalization technique is very operative to enhance numerous types of pictures when the appropriate structures (local information) can be removed.

***Extension to Histogram Equalization***

In 2006 to 2014 numerous works maintained the consequence of a contrast enhancement has an significant portion in image processing presentations [4-7]. They defined that conventional contrast enhancement method frequently flops to generate acceptable results for a broad variety of low-contrast images. A new programmed way for contrast enhancement is announced. Firstly they assembled the histogram constituents of a low-contrast picture into a appropriate number of bins as stated by a certain criterion, then restructured these bins consistently over the gray scale, and lastly ungroup the earlier grouped gray-levels. That's why, these new method is named GLG (gray-level grouping). GLG not only creates results better than conventional contrast enhancement procedures, but is also fully spontaneous in most incidents, and is suitable to broad differences of images. An accumulation of gray-level grouping is SGLG (selective GLG). SGLG selectively assemblies and disassembles histogram ingredients to attain particular application determinations.

GLG was a universal and influential method, which can be appropriate routine, pragmatic to a unambiguous variety of low-contrast images and produces agreeable results. HE method could be directed with full computerization at reckless hurries.

In 2007 a modified Histogram equalization (HE) has demonstrated to be a modest and operative image contrast enhancement procedure [6]. It operated on a fresh practice called Multi-HE, which unvaryingly of disintegrating the input image into various sub-images, and then applying the classical HE process to each one. This structure succeeds a less rise produce image contrast enhancement, in a way that the output image presents a more usual look. It proposed two disagreement purposes for image disintegrating, imagining two new Multi-HE methods. A cost duty was also used for automatically determining in how many sub-images the input image will be disintegrated on. The work was confirmed a new arrangement called MHE for image contrast enhancement and brightness preserving which produced natural looking images. The results exposed that there procedure was improved on preserving the brightness of the processed image (compare to the original image) and produce images with natural presence, at the rate of contrast enhancement.

Similarly in [8] it was quantified that the HE procedure was not very well suited to be useful in customer electronics.

**Figure 5.** Dualistic Sub-Image Histogram Equalization.

They deliberated that one of the explanations to overawed this feebleness is by conserving the mean brightness of the input image inside the output image. They delivered the improved dualistic sub image HE method which protects the brightness of the image. They deliberated results of first five methods that are obtainable for contrast enhancement and brightness preservation such as conventional global HE, local HE, ADPHE, BBHE, DSIHE. The last method as MDSIHE gives improved outcomes than all other.

In 2009 a work was found [7] that can improve the contrast in the areas where the pixels have alike intensities, they represented a new histogram equalization arrangement. Conventional global equalization arrangements over-equalize these sections so that too bright (sunny) or dark(dim) pixels are caused and local equalization schemes yield unforeseen disjointedness at the borders of the blocks. The planned procedure fragments the unusual histogram into sub-histograms with regard to brightness level and equalizes each sub-histogram with the certain ranges of equalization considering its mean and variance. By the weighted sum of the equalized images gained by using the sub-histogram equalizations we can determine the final image. By preventive the supreme and minutest varieties of equalization operations on individual sub-histograms, the over-equalization effect is eradicated.

**Brightness Preserving Techniques Application in Image Enhancement:-**

In [5] a fresh LBPDHE (local brightness preserving dynamic histogram equalization) algorithm for contrast enhancement is clarified. Earlier contrast enhancement mechanism have exposed the pluses of histogram partitioning before histogram equalization to evade over or under enhanced images. Furthermore, brightness preservation has been documented as one of the vital possessions for contrast enhancement structures. Brightness preservation is significant for reducing energy intake in consumer electronic goods, such as liquid crystal displays (LCD) and televisions. The chief indication of that work was the opinion that brightness preservation could be executed locally and independently for all parts, rather than universally over the whole histogram. Founded on eighty test images, investigational outcomes specify that their projected scheme can not only generate good contrast enhanced pictures, but also accomplish the best mean brightness preservation when matched with the other state-of-the-art approaches. It supplements the DHE method with a simple, yet significant local mean brightness preserving technique. Founded on 80 test images, experimental results show that their planned LBPDHE method not only has good contrast enhancement, but also attains the best brightness preservation.

Chao Wang and Zhongfu Ye in 2005 [3] operated for conserving the unusual brightness to evade irritating artifacts. This delivered an allowance of histogram equalization, really histogram comprehensive explanation, to overwhelmed disadvantage of HE. To exploit the entropy is the main idea of HE to make the histogram as smooth as probable. Following that, the core of the planned algorithm, named BPHEME (Brightness Preserving Histogram Equalization with Maximum Entropy). They related BPHEME to the prevailing methods including HE, BBHE (Brightness preserving Bi-Histogram Equalization), equal area DSIHE (Dualistic Sub-Image Histogram Equalization), and MMBEBHE (Minimum Mean Brightness Error Bi-Histogram Equalization), experimental results express that BPHEME can not only enhance the image effectually, but also reserve the original brightness perfectly well.

**Figure 6.** Mean Brightness Preserve Histogram Equalization

Brightness Preserving Histogram Equalization with Maximum Entropy used to locate the optimal histogram (Figure 5), which has the maximum differential entropy under the mean brightness constraint, and then accomplishes the histogram specification under the instruction of that desired histogram. Experimental outcomes display that BPHEME can enhance the image pretty well when conserving the mean brightness, which is very appropriate for consumer electronics such as TV.

**Image Enhancement In Frequency Domain-**

In frequency domain approaches, the pixel value is first moved in to domain procedures by applying Discrete Cosine Transform and Discrete Wavelet Transform based fusion ways and added image is enhanced by shifting frequency component of an image. Various fusion methods are discussed below:-

a.) Laplacian Pyramid Fusion Method :-

The fundamental notion behind the Laplacian pyramid is to implement a pyramid decomposition on every single source image, then integrate of these disintegrations to make a composite demonstration and finally restructure the fused image by applying an Inverse Pyramid Transform [9]. Laplacian pyramid based fusion scheme uses follow:

1. The initial step is to make a pyramid for every single source image.
2. Then the fusion is applied using a feature selection judgment method at every single level of the pyramid.
3. The feature selection method chooses the most significant arrangement from the source image and duplicates it to the combined pyramid.

4. Finally, by executing an inverse pyramid transform fused image is attained.

b.) Discrete Cosine Transform (DCT) :-

Spatial domain image fusion approaches are complex and time overriding which are problematic to be accomplished on real-time images. Fusion tactics are very proficient when the source images are coded in Joint Photographic Experts Group (JPEG) format or when the fused image will be saved or communicated in JPEG format which are smeared in DCT . An image is first sectioned into blocks of 8x8 pixels to execute the JPEG coding, then on every single block DCT (Discrete Cosine Transform) is applied. This creates 64 measurements (coefficients) which are then quantized to decrease their magnitude [10]. The measurements are then reordered into a one-dimensional array in a crisscross way before additional entropy encoding takes place. The compression is realized in two steps the first is during quantization and the second during the entropy coding procedure. Encoding is the reverse process of JPEG decoding [11].

c.) Discrete Wavelet Transform (DWT) :-

The wavelet transform crumbles the image into low-low, high-low, low-high and high-high spatial frequency bands at different gauges [12]. The LL(low-low) band comprises the guesstimate coefficients whereas the other bands contain directional information due to spatial coordination. HL(high-low) band comprises the vertical detail coefficients. LH(low high) band comprises the horizontal detail coefficients. HH(high-high) comprises the diagonal detail coefficients and also contain the higher absolute values of wavelet coefficients characterize prominent features such as edges or lines [13]. Figure 3 shows DWT (Discrete Wavelet Transform) based image fusion. The wavelets-based method executes the following responsibilities:-

1. It is a multi-resolution methodology well-matched to cope the different image resolutions. It is Suitable in a number of image processing applications containing the image fusion [14].
2. The DWT (Discrete wavelets transform) permits the image decomposition in different kinds of coefficients conserving the image information.
3. Such coefficients approaching from different images can be properly joined to achieve new coefficients so that the evidence in the original images is composed correctly.
4. After the coefficients are combined then the concluding fused image is accomplished by applying the IDWT ( inverse discrete wavelets transform), where the information in the merged coefficients is also conserved.

**Image Enhancement Application in Real Time :-**

In 2004 operated on the presentation of fingerprint recognizer, which extremely rest on on the fingerprint image quality. Various forms of noises in the fingerprint images position more trouble for recognizers. They concentrated on an effective approach of cleaning the valleys between the ridges contours are lacking. It was originate that noisy valley pixels and the pixels in the interrupted ridge flow gap are “impulse noises". They defined a afresh methodology to fingerprint image enhancement, which is lied on integration of DMF (directional median filter) and Anisotropic Filter. In this paper Gaussian-distributed noises are minimized efficiently by Anisotropic Filter. “Impulse noises" are reduced capably by DMF. The enhancement procedure has been instigated and tested on fingerprint images from FVC2002. Images of changing quality have been used to evaluate the performance of their approach. They compared the proposed work with other methods in terms of missed details, spurious details, matched details and flipped details between end points and bifurcation points. Outcomes revealed for their model can effectively reduce Gaussian-distributed noises by anisotropic filter and impulse noises along the direction of ridge flow (by DMF). This algorithm may flop when image areas are tainted with large attenuation and alignment field in these expanses can hardly be predictable.

In 2006 worked on application of toll rate charged for the usage of services such as a tunnel or a bridge is usually proportionate to the number of axles obsessed by a vehicle. They intended an automatic organism that can detect the number of axles is preferred. Instead of axle discovering, wheels of a vehicle were verified and a method based on the Hough transform for detecting circles was projected. As the organism must be clever to detect the accurate number of wheels in real-time, sub-sampling based on the Haar Wavelet transform was applied. The approach was able to identify the wheel correctly to method the input images in real-time.

They accomplish that the Hough transform is suitable for such an application. It can process up to twenty four images within 1.5 seconds and it gratified the timing constraint imposed upon the system. The system setup was simple and by using commodity components, its setup charge was also low.

## III. RESULTS

As it can be analyzed from the above explained work and figure that up to a certain extent this methodology can avoid the possible inversions, however complete avoidance is still missing.
Transformations show that how important it can be with the higher data width, as it allows the mathematical operations to get implemented. Hence they enhance the security and the complexity of the transmitted data.
Secure data transmission is a very sensitive sector of the communication as it holds the relative information and also it should not get revealed to any unauthorized channel. Through this paper it has been shown that by transforming the one dimensional text to two dimensional texts not only security can be enhanced but also the transmitted data becomes error resistive up to a certain extent which can be pivotal during the data recovery at the receiver end.

## IV. CONCLUSION

During the development of this paper and whole research work it has been observed that there is no such methodology has been proposed or articulated till now about the transformation of the array dimensions and also about the error resistive nature of the transmitted data. This has been by far the highlight of this paper and the complete work, however most of the papers studied and observed during the development phase of this paper and research.
The transmitted data is not of precise format and can be transformed and altered into any other format and this system is so flexible with its working nature that any type of data can be encoded using this system with few changes in the input style, which was not convincible with the previous designs.

## V. REFERENCES


[1]. C. V. Jawahar, *et al.,* "Investigations on Fuzzy Thresholding Based on Fuzzy Clustering", Pattern Recognition Society, Published by Elsevier Science Ltd, **(1997).**

[2]. C. Wu, Z. Shi and V. Govindaraju, "Fingerprint Image Enhancement Method Using Directional Median Filter", Preprint submitted to Elsevier Science, **(2004)**.

[3]. S.-D. Chen, A. R. Ramli, "Preserving brightness in histogram equalization based contrast enhancement techniques", Elsevier Inc. All rights reserved. doi:10.1016/j.dsp.2004.04.001, **(2004).**

[4]. Y.-F. Fung, H. Lee and M. F. Ercan, "Image Processing Application in Toll Collection", IAENG International Journal of Computer Science, IJCS_32_4_15, vol. 32, pp.

[5]. Z. Chen, B. R. Abidi, D. L. Page and M. A. Abidi, "Gray-Level Grouping (GLG): An Automatic Method for Optimized Image Contrast Enhancement—Part I: The Basic Method", IEEE Transactions on Image Processing, vol. 15, no. 8, **(2006)** August.

[6]. D. Menotti, L. Najman, J. Facon and A. de A. Araújo, "Multi-Histogram Equalization Methods for Contrast Enhancement and Brightness Preserving", IEEE Transactions on Consumer Electronics, vol. 53, no. 3, **(2007)** August.

[7]. T. Arici, S. Dikbas and Y. Altunbasak, "A Histogram Modification Framework and Its Application for Image Contrast Enhancement" IEEE Transactions on Image Processing, vol. 18, no. 9, **(2009)** September.

[8]. C. Wang and Z. Ye, "Brightness Preserving Histogram Equalization with Maximum Entropy: A Variational Perspective" IEEE Transactions on Consumer Electronics, vol. 51, no. 4, **(2005)** November.

[9]. Wang, Wencheng, and Faliang Chang. "A multi-focus image fusion method based on Laplacian pyramid." *Journal of Computers* 6.12 (2011): 2559-2566.

[10]. Singh, Jagdeep, and Vijay Kumar Banga. "An Enhanced DCT based Image Fusion using Adaptive Histogram Equalization." *International Journal of Computer Applications* 87.12 (2014): 26-32.

[11]. Y.AsnathVictyPhamila, R.Amutha. “Discrete Cosine Transform based fusion of multi-focus images for visual sensor networks.” In Signal Processing, 2013 International Conference on, pp.161-170. IEEE, 2013.

[12]. Om Prakash, Richa Srivastava, Ashish Khare. “Biorthogonal Wavelet Transform Based Image Fusion Using Absolute Maximum Fusion Rule.” In Image processing, 2013 International Conference on Information and Communication Technologies, pp. 577-582. IEEE, 2013.

[13]. O.Rockinger. “Image sequence fusions using a shift-invariant wavelet transform.” In image processing, 1997 International Conference on, vol. 3, pp. 288-291. IEEE, 1997.

[14]. Ali, Syed Twareque, Jean-Pierre Antoine, and Jean-Pierre Gazeau. "Discrete Wavelet Transforms." *Coherent States, Wavelets, and Their Generalizations*. Springern New York, 2014. 379-410.