Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

A Study And Analysis of Image Enhancement Techniques

Chand C. R Vimal

Bachelor of Computer Application Department, K.G College Of Arts AndScience,Coimbatore, Tamilnadu-35
Email- crvimal2k19@gmail.com

ABSTRACT

One of the major issues in image processing is Image enhancement problems. The purpose of Image enhancement is to make an image that is more suitable than original image for specific application and processing. Digital image enhancement methods provide a lot of opportunities for improving the visual quality of images. Appropriate method of such techniques is very important. This paper will provide a study and analysis of different techniques commonly used for image enhancement. Image enhancement has a fundamental role in vision applications. Even though much work is completed in the field of image enhancement, many techniques have previously been proposed for enhancing in the field of digital images. In this paper, a study and comparison on various image enhancement techniques has been done.

KEYWORDS: Digital Image Processing, Histogram Equalization, Image Enhancement.

***Corresponding author**

C. R Vimal Chand

Bachelor of Computer Application Department,

K.G College Of Arts And Science,Coimbatore,Tamilnadu-35

Email- crvimal2k19@gmail.com

I. INTRODUCTION

Different methods of image and pictures are used as the source of information in present day applications and communication system. When an image is taken some of the degradation may occur like blurred image. If an image is converted from one form to another form such as scanning, transmitting, storing etc., some of the degradation occurs in the output. So the output image must need to improve for the better visual appearance of an image. [1,2,3,4]There are some important operations like Image denoising, enhancement and sharpening in the general fields of image processing and computer vision. Enhancement of noisy image is a very complicated task in many research and application area. There are many techniques to improve the visual appearance of an image, like image enhancement, image deblurring, image sharpening, image smoothing, image filtering and various noise removing methods.

Image enhancement methods consist of improving the appearance of an image or to convert the image to a form better suited for analysis by a human or a machine. Enhancement of image is very difficult issue in many research and application areas. Image enhancement processes are used to improve certain features by modifying the colors or intensities[5,6,7]. Technique applied for enhancing images are applicable for medical image processing and image processing application fields like satellite image processing, biometric image processing etc.

II. IMAGE ENHANCEMENT TECHNIQUES

[8,9,10]Many techniques and processes are used for image enhancement, which are given below.

A. Histogram equalization

Histogram equalization[11,12] is a very common method for enhancing the images. If we have an image which is predominantly dark. Then when we process a histogram it would be skewed towards the lower end of the grey scale and all the image detail is compressed into the dark end of the histogram. If that histogram is `stretch out' the grey levels at the dark end to make a more uniformly distributed histogram then the image would become much clearer. Histogram equalization is the method of stretching the histogram across the entire spectrum of pixels (0 – 255). It increases and improves the contrast of images for the finality of human inspection and can be applied to normalize illumination variations in image understanding problems. Histogram equalization is one of the methods that can be applied to obtain new images based on histogram specification or modification. It is considered a global technique. This process is quite simple for creating new pixel and for each brightness level j in the original image, the new pixel level value (k) is calculated as given in equation 1.

$$K = \sum_{i=0}^{j} \frac{N_i}{T} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots$$

Equation 1.

Where the sum gives the number of pixels in the image with brightness equal to or less than j, and T is the total number of pixels. The main function of histogram equalization is to find gray level transformation function (T) to transform image f such that the histogram of T (f) is equalized.

B. Adaptive histogram equalization

Histogram equalization gives active range of strength value whiles squash the histogram. Histogram equalization On many images provides suitable results, but suitable to its global treating of the image, sometimes it more than enhance the image. It's used to enhance difference in images. [13,14]Histogram equalization gives important only on local compare subject of overall compare. Adaptive histogram equalization overcomes all of these topics, this technique appropriate for general techniques. When the image contain region that are expansively lighter and darker, the contrast in those regions will not be sufficiently enhanced. So adaptive histogram equalization calculate correctly image region. Adaptive histogram equalization improves the contrast of images by transforming the values in the intensity of an image. The contrast transform means the calculation for each of these regions independently. In the optimal size of region depends on the type of the input image, and it is superiorly determined during experimentation.

C. Fuzzy Logic Technique

Fuzzy-logic method has been efficiently applied in different elements of image processing. Recently fuzzy based algorithms for image enhancement have been developed that shows better performance when com-pared to conventional and other advanced techniques like GLG. Fuzzy image processing involves mainly three stages: image fuzzification, modification of membership values, and, if necessary, image DE fuzzification. When the image data are transformed from gray-level domain to the fuzzy membership domain (fuzzification), appropriate fuzzy techniques modify the membership values.

Figure 1. The main principle of Fuzzy Image enhancement

D. Nuro Fuzzy System

Neuro-fuzzy systems are the fuzzy system improved with Artificial Neural Network (ANN). ANN finds out the properties of data samples by processing it. Predictive power of ANN is considered more than that of signal analysis techniques nowadays. [16,17]Fuzzy set theory is applicable, for dealing with uncertainty. Neuro-Fuzzy system based on where the fuzzy rules and sets are adjusted using neural network techniques in iterative steps followed with the set of pair of input and output data vectors. This system behaves like a neural network where learning of parameters occurs and at the time of execution it behaves like a fuzzy.

Neural network will identify types of noise such as if it is salt and pepper, gaussian and non-gaussian noise. After that Fuzzy logic will apply proper filter based on type of noise.

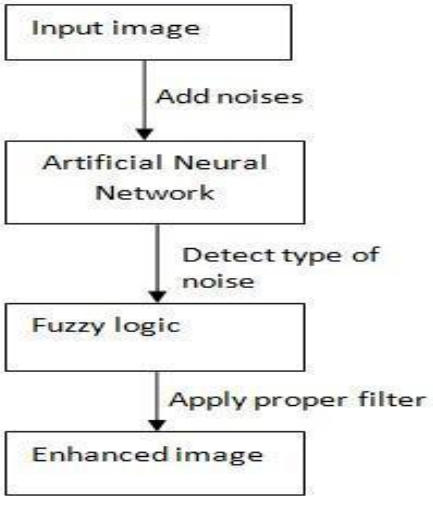

Figure 2. The principle of Nuro-Fuzzy Image enhancement

D. Unsharp Masking

In the un-sharp masking (UM) method for image enhancement, the process includes fraction of the high-pass filtered image to the original one to form the enhanced image. In this technique, un-sharp masking is applied in partial way for detecting the edges and boundary lines in the image and then a conservative smoothing operation is applied on the selected areas to remove uncertain edges which represents the salt and pepper noise. Totally, the noise free edge image is added with the smoothed image to get the improved original image with reduced noise. The input/output process for the un-sharp masking filter can be written as follows:

$$X' = X + \lambda Z \quad \ldots\ldots\ldots\ldots\ldots$$

Equation 2.

Where the inputs and output images are processed and is a positive constant which controls the fraction of the high-pass filtered image z to be added to the input image.

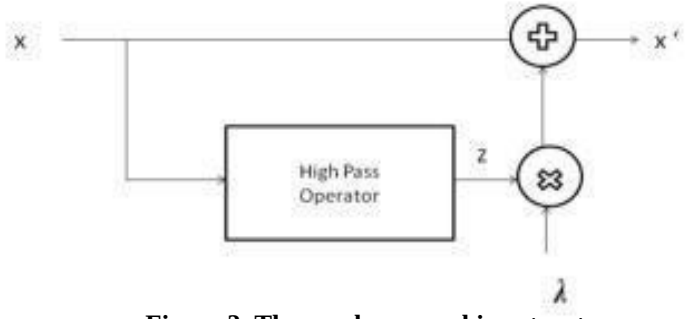

Figure 3. The un-sharp masking structure

F. Contrast Stretching

To Improve the range of brightness values in an image the contrast enhancement techniques are used, so that the image can be efficiently displayed in a manner desired by the analyst. The level of contrast in an image may differ due to poor illumination or improper setting of the acquisition sensor device. [16,17]Therefore, there is a need to manipulate the contrast of an image in different levels and an image to overcome for difficulties in image acquisition. The method of contrast stretching is to increase the dynamic range of the gray levels in the image being processed. The method is to modify the dynamic range of the grey-levels in the images. One of the simplest contrast stretch algorithm is Linear Contrast Stretch that stretches and converts the pixel values of a low-contrast image or high contrast image by extending and improving the dynamic range across the whole image spectrum from 0 – (L-1).

G. Thresholding Transformations

Thresholding transformations are applied and useful for segmentation process in which we want to isolate an object of interest from a background. Image threshold is the method of separating the information (objects) of an image from its background, hence, thresholding is frequently applied to grey-level or color document scanned images. Thresholding can be divided into two main categories: global and local. Global thresholding methods choose single threshold value for the entire document image, which is often based on the estimation of the background level from the intensity histogram of the image; hence, it is called as a point or pixel processing operation. Global thresholding methods automatically reduce a grey-level image to a binary image. The images taken to process using such methods are assumed to have two classes of pixels (foreground and background). The objective of a global thresholding method is to automatically specify a threshold value T, where the pixel values below

it is considered foreground and the values above are background. A simple method would be to select the mean or median value of all the pixels in the input image, the mean or median will work best as the threshold, even though, this will generally violate in the case especially if the pixels are not uniformly distributed in an image.

Local adaptive thresholding uses different values for each pixel according to the local area information. Local thresholding techniques are used with document images having non-uniform background illumination or complex backgrounds, such as watermarks found in security documents if the global thresholding methods fail to separate the foreground from the background. This is due to the fact that the histogram of such images provides more than two peaks making it difficult for a global thresholding technique to separate the objects from the background, thus; local thresholding methods are the solution.

H. Log Transformations

The log transformation converts a narrow range of low input grey level values into a wider range of output values. The inverse log transformation does the opposite transformation. Log functions are particularly useful when the input grey level values may have[18,19,20] an extremely large range of values. Sometimes the dynamic range of a processed image far exceeds the capability of the display device, in this case only the brightest parts of the images are visible on the display screen. [24]To solve this problem an effective way to compress the dynamic range of pixel values is to use the Log Transformations, which is given by,

$$g(x, y) = c.\ \text{Log}\ (1 + r)) \ldots\ldots\ldots\ldots\ldots$$

Where c is constant and it is assumed that $r \geq 0$.This transformation maps a narrow range of low-level grey scale intensities into a wider range of output values. [23]Log Transformations is used to expand values of dark pixels and compress values of bright pixels. Inverse log transform function is used to expand the values of high pixels in an image while compressing the darker-level values. Inverse log transform function maps the wide range of high-level grey scale intensities into a narrow range of high level output values.

I. Log Transformations

Previous discussed methods of histogram equalizations and histogram matching are global. So, local enhancement method is used. Define square or rectangular neighborhood (mask) and move the center from pixel to pixel. For each neighborhood, calculate histogram of the points n the neighborhood

obtains histogram equalization /specification function. [21,22]Map gray level of pixel centered in neighborhood. It can use new pixel values and previous histogram to calculate next histogram.

Comparative Analysis of all Image Enhancement techniques are given below as tabular format.

Table No:1"Comparative Analysis Of Image Enhancement Techniques"

S.No	TECHNIQUES	ADVANTAGES
1	Histogram Equalization	This technique is very simple. Only the global histogram equalization can be done completely automatically.
2	Adaptive Histogram Ħistogra Equalization	This method has advantage of being quick making it simple based on transform adaptive histogram. The results of this technique shows outperform from commonly used enhancement technique like histogram equalization.
3	Fuzzy Logic Technique	The fuzzy rule-based approach is a powerful method for formulation of expert system in a comprehensive way. Fuzzy logic represents the good mathematical frame works to deal with uncertainty of information.
4	Nuro Fuzzy System	The neural networks used for identification of noise using the statistical parameters whereas fuzzy logic is used for enhancement purpose. The system behaves like a neural network where learning of parameters occurs and at the time of execution it behaves like a fuzzy.
5	Unsharp Masking	This is the simple technique. In this technique, a fraction of the high-pass filtered image is added to the original one to form the enhanced image. It has two major drawbacks. First it enhances the noise present in the image. Second, it enhances too much the sharp transitions which lead to excessive overshoot on sharp edges.
6	Contrast Stretching	Contrast Stretch is the simplest contrast stretch algorithm that stretches the pixel values of a low-contrast image or high-contrast image by extending the dynamic range acros the whole image spectrum
7	Thresholding	Thresholding transformations are particularly useful for

	transformations	segmentation in which we want to isolate an object of interest from a background.
8	Log Transformation	Log Transformation is Useful for enhancing details in the darker regions of the image at the expense of detail in the brighter regions the higher-level values.
9	Local Enhancement	This technique is very simple to use. In this technique we define a define square or rectangular neighborhood and move the center from pixel to pixel.

III. CONCLUSION AND FUTURE WORK

Above table discuss those different techniques and their advantages. This paper studies some of the areas where image enhancement is done. This paper presents the most and simplest important techniques for image enhancement in digital image processing. Although this paper did not involve the computational cost of enhancement techniques it may play a critical role in choosing a technique for real time applications. Differ the effectiveness of each of these algorithms when applied separately, in practice one must devise a combination of such methods to achieve more effective image enhancement.

IV.REFERENCES

1. Harmandeep Kaur Ranota and Prabhpreet Kaur "Review and Analysis of Image Enhancement Techniques" International Journal of Information & Computation Technology, © International Research Publications House, ISSN 0974-2239, 2014; 4(6): 583-590.
2. Shikha M ahajan and Richa Dogra "A Review on Image Enhancement Techniques" International Journal of Engineering and Innovative Technology (IJEIT),May 2015; 4(11).
3. Shweta K. Narnaware, and Roshni Khedgaonkar "A Review on Image Enhancement using Artificial Neural Network and Fuzzy Logic" (IJCSIT) International Journal of Computer Science and Information Technologies, 2015; 6(1) .
4. Sasi Gopalan, Madhu S Nair and Souriar Sebastian "Approximation Studies on Image Enhancement Using Fuzzy Technique" International Journal of Advanced Science and Technology, September 2009;10: 11 -26.
5. Zhengmao Ye, Habib Mohamadin, Su-Seng Pang, Sitharama Iyengar "Contrast Enhancement and Clustering Segmentation of Gray Level Images with Quantitative Information Evaluation" Weas Transaction on Information Science & Application, February 2008; 5: 181.

6. J.C. Russ, the Image Processing Handbook, CRC Press, Boca Raton, FL., 1992.
7. S. E. Umbaugh, "Computer Vision & Image Processing, " Prentice Hall PTR, 1998.
8. R. Jain, R. Kasturi and B.G. Schunck, Machine Vision, McGraw-Hill International Edition, 1995.
9. R.M. Haralick, and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison Wesley, Reading, MA, 1992.
10. W. K. Pratt, Digital Image Processing, JohnWiely and Sons, New York, NY, 1991.
11. Jianwei Ma and Gerlind Plonka " Curvelets and Recent Applications" 2010. Based on Homogeneity Level Information," IEEE Trans. Image Processing, Jan. 2003; 12: 85–92.
12. E. Abreu, M. Lightstone, S. Mitra, and K. Arakawa, "A new efficient approach for the removal of impulse noise from highly corrupted images," IEEE Trans. Image Processing, June 1996; 5: 1012-1025.
13. K. S. Srinivasan and D. Ebenezer, _A new fast and efficient decision based algorithm for removal of high density impulse noises, IEEE Signal Process. Lett, Mar. 2007; 14(3): 189–192.
14. S. P. Awate and R. T. Whitaker, "Higher-order image statistics for unsupervised, information-theoretic,adaptive, image filtering," in *Proc IEEE Comput. Soc. Conf. Comput. Vis. Pattern Recognit.*, Jun 2005; 2: 44–51.
15. T. Batard and M. Berthier, "Spinor Fourier transform for image processing," *IEEE J. Sel. Topics Signal Process.*, Aug. 2013; 7(4): 605– 613.
16. P. Blomgren and T. F. Chan, "Color TV: Total variation methods For restoration of vector-valuedimages," *IEEE Trans. Image Process*, Mar. 1998; 7(3):304–309.
17. A. Buades, B. Coll, and J.-M. Morel, "A non-local algorithm for image denoising," in *Proc. IEEE Comput. Soc. Conf. Comput. Vis. Pattern Recognit.*, Jun. 2005; 2: 60–65.
18. M. Lebrun, "An analysis and implementation of the BM3D Image denoising method," *Image Process. On Line*, Aug. 2012; 2: 175–213.
19. M. Lebrun, M. Colom, and J. M. Morel, "The noise clinic: A universal blind denoising algorithm," in *Proc. IEEE Int. Conf. Image Process* Oct. 2014; 2674–2678.
20. A. Levin and B. Nadler, "Natural image denoising: Optimality and inherent bounds," in *Proc.IEEE Int. Conf. Comput. Vis. Pattern Recognit.*, Jun. 2011; 2: 2833–2840
21. M. Lysaker, S. Osher, and X.-C. Tai, "Noise removal using Smoothed normals and surface fitting," *IEEE Trans. Image Process.*, Oct. 2004; 13(10): 1345–1357.

22. S. Osher, M. Burger, D. Goldfarb, J. Xu, and W. Yin, "An Iterative regularization method for total variation-based image restoration," *Multiscale Model. Simul.*, 2005; 4(2): 460– 489.

23. T. Rahman, X.-C. Tai, and S. Osher, "A tv-stokes denoising algorithm," in *Scale Space and Variational Methods in Computer Vision* (Lecture Notes in Computer Science), Berlin, Germany, Springer Verlag, 2007; 4485: 473–483.

24. Dr.G.paramasivam, Study and analysis of various image fusion algorithms, "International journal of basic and applied research", June 2018; 8(6): 1059-1067.