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REVIEW ARTICLE

Methods for Image Enhancement: A Review

Cheenu Sharma[#1], Manshi Shukla*[2]

#M. Tech, Research Scholar, Department of Computer Science and Engineering, RIMT-IET, Mandi Gobindgarh, Fatehgarh Sahib, Punjab, India

[1] cheenu.sharma90@yahoo.com

*Assistant Professor, Department of Computer Science and Engineering, RIMT-IET, Mandi Gobindgarh, Fatehgarh Sahib, Punjab, India

[2] manshishukla07@gmail.com

Abstract— Image Enhancement is one of challenging areas of image processing. Loss of information takes place as image clarity is affected by lighting, or equipment used to capture the image. Enhancement operations include improving the quality, removing noise & blurring and to bring out the hidden details without addition of unreal visual appearances. Different techniques are applied on different images as one technique does not work for all the applications. This paper gives a survey on methods used for enhancement of images.

Keywords— Image Enhancement, Spatial Domain, Frequency Domain, Grayscale, Histogram Equalization

I. INTRODUCTION

Image Enhancement problem includes low quality image as input and gives as output a high quality image. An image with high dynamic range consists of both bright and dark regions. It becomes difficult for human eyes to percept such images because of increase in dynamic range of sensing by human eye. Many important areas such as vision, remote sensing, dynamic scene analysis [1], autonomous navigation, and biomedical image analysis [2] require image modification to show the information in a better way and reveal the important content. Enhancement helps in increasing the dynamic range of features that are selected for enhancing so that their detection becomes easy. It does not increase the content data.

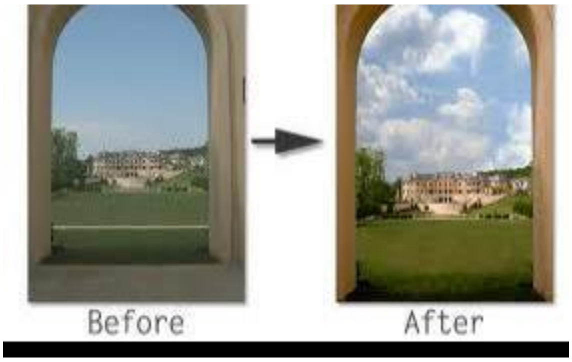

Fig. 1[3] Diagram showing original and enhanced image

Image enhancement techniques have been divided into two broad categories: Spatial Domain and Frequency domain.

II. METHODS FOR IMAGE ENHANCEMENT

A. Spatial Domain

Spatial domain deals with manipulation of pixels and thus improves overall contrast of the entire image. The main advantages of spatial based methods are simple to understand and less complex which favour real time implementations. However as image enhancement is done in a uniform manner it may produce undesirable results and one cannot enhance the edges by selectively choosing them [4]. Other limitation is that it can smoothen even those objects which require accurate details [5]. It comprises of two main categories:

1) *Point Processing operation (Intensity transformation function):* A pixel is chosen and enhancement operation applied on it. Representation is done as follows:

$$g(x, y) = T\,[f(x, y)] \tag{1}$$

Where f(x, y) is input image & g(x, y) is the output image,

T is the operator used for transformation.

Intensity transformation consists of controlling the brightness, contrast stretching, thresholding, gamma correction and histogram equalization. Histogram equalization (HE) is one of the basic and popular techniques in spatial domain and works on all types of images [3], which attempts to distribute frequencies on the histogram by spreading out the most frequent intensity values. The Horizontal axis on the histogram represents the intensity values while and vertical axis represents number of pixels of particular intensity. This method works well with images in which foreground and background are either both dark or both are dull.

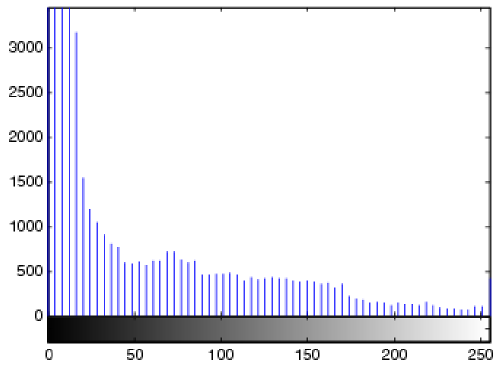

Fig.2 Histogram of input image

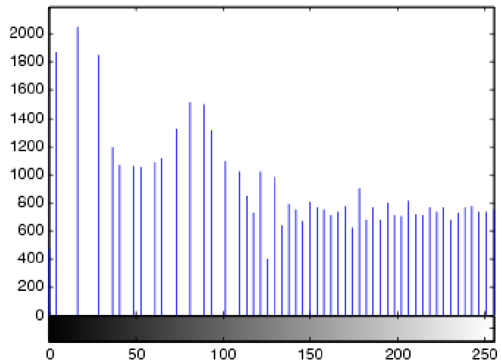

Fig. 3 Histogram of enhanced image

Conventional Histogram equalization technique cause excessive contrast enhancement. In recent years others variations of Histogram equalization have also been developed.

Brightness Preserving Bi-Histogram Equalization (BBHE) [6] separates the image histogram into two parts and is presented by the input mean, which is the average intensity of all pixels that construct the input image and equalization is applied on both the parts independently. Dualistic Sub Image Histogram Equalization (DSIHE) [7] divides the image into two equal area sub images based on gray level probability density function after which equalization takes place and images are recombined. Minimum Mean Brightness Error Bi Histogram Equalization (MMBEBHE) [8] is the extension of BBHE. It breaks the image into two parts by using a threshold level and achieves minimum brightness difference between input and output image. Mean Brightness Preserving Histogram Equalization (MBPHE) combines BBHE, DSIHE, MMBEBHE. In Recursive Mean- Separate Histogram Equalization (RMSHE) [9] instead of decomposing the image into two parts it decomposes it recursively up to the scale p, generating 2p images. Although it leads to improvements but side effects are also observed. In Dynamic Histogram Equalization (DHE) [10] input histogram broken into sub histograms and ensures that there exists no dominating component in them. Equalization is then applied and each sub component occupies a specified gray level range in enhanced image. The main advantage is that it does not produce severe side effects. In Brightness Preserving Dynamic Histogram Equalization (BPDHE) [11] the mean intensity of output image is almost equal to mean intensity of input image thus maintains the mean brightness of the image.

2) *Spatial filtering*: It works on neighbourhood of every pixel in an image. Operations such as image sharpening, Noise reduction, edge enhancement are performed. In linear filters the output is the weighted sum of input pixels. These filters can be linear or nonlinear. Linear filters are smoothing or low pass filter, sharpening filter or high pass filter, Laplacian filter, Un-sharp masking, High boost filter.

   In Non linear filters enhanced image is not linearly related to pixels in the neighbourhood of original image. Nonlinear filters include order statistic filters like Median filter, Max & Min filter.

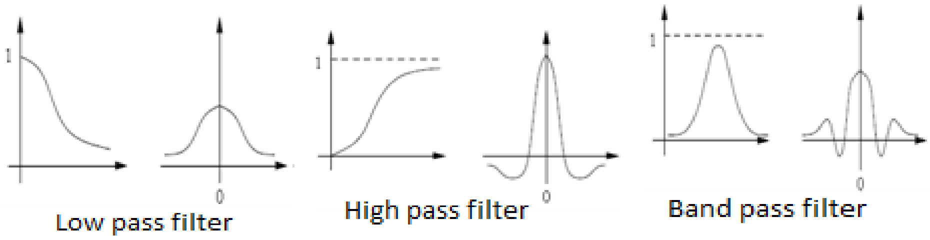

Fig. 4 Spatial Filtering

Spatial domain methods enhance the quality of image but at the same time enhance the noise.

B. Frequency Domain Methods

It uses a straight forward technique for enhancement. It takes the original image and computes its Fourier transform and multiplication is done by a filter. At the end inverse transform is applied to reach the enhanced image [12]

It is represented as: $q(x, y) = h(x, y)* p(x, y)$ (2)

Where q (x,y) is the processed image , p(x, y) is the given image and h(x,y) is the function used for transformation.

Frequency Domain methods include:

1) *Low Pass Filtering:* A low pass filter smoothes edges & sharp transitions as the gray levels contribute to the high frequency content of its Fourier transform. Elimination of low frequency components takes place.
2) *High Pass Filtering:* It can sharpen edges by downgrading the low frequency components without disturbing the high frequency information.
3) *Band-pass filtering:* Here reflectance and illumination components can be filtered independently. It associates the low frequencies of the Fourier transform of the natural log of an image with illumination and high frequencies with reflectance thus it is filtered individually.

However frequency domain does not enhance the image in a uniform manner. Mainly used for enhancing edges.

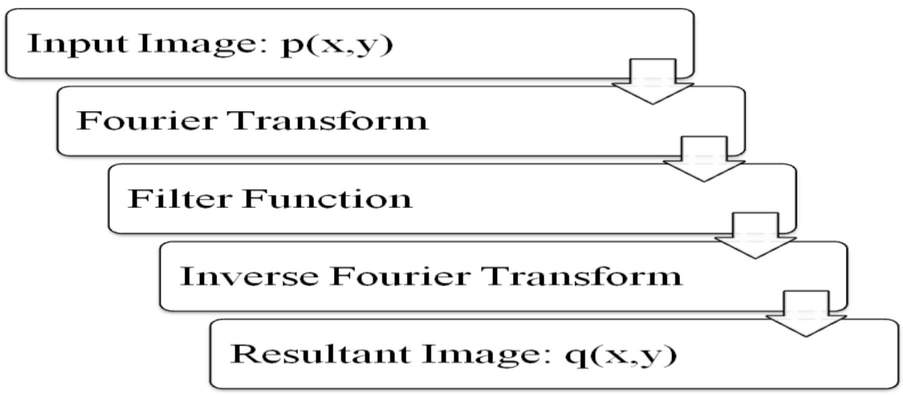

Fig.5 Diagram showing steps in Frequency Domain Technique

III. CONCLUSIONS

Enhancement algorithms provide a better view by modifying images. The technique used for enhancement is problem dependent. The extent to which image is enhanced is dependent on the observer .Two categories of enhancement methods are discussed each with their types and advantages. Spatial domain methods improve the overall contrast of images by manipulating the pixels. Frequency domain methods are used to enhance the selected objects mainly the edges.

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REFERENCES

[1] Renbin Peng, *Noise-Enhanced and Human Visual System Driven Image Processing: Algorithms and Performance Limits*, Syracuse University Electrical Engineering and Computer Science Dissertations, Jan 1,2011.

[2] Chahat Chaudhary, Mahendra Kumar Patil, *Review Of Image Enhancement Techniques using Histogram Equalization*, International Journal of Application or Innovation in Engineering & Management (IJAIEM) Volume 2, Issue 5, May 2013 ISSN 2319 – 4847.

[3] Ruchika Mishra, Utkarsh Sharma, *Review of Image Enhancement Techniques* **,** International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 8, August – 2013 ISSN: 2278-0181.

[4] S.S. Bedi1, Rati Khandelwal , *Various Image Enhancement Techniques- A Critical Review,*International Journal of Advanced Research in Computer and Communication Engineering Vol. 2, Issue 3, March 2013.

[5] Nirmala S. O ,T. D. Dongale ,R. K. Kamat, Review *on Image Enhancement Techniques: FPGA Implementation perspective,* International Journal of Electronics Communication and Computer Technology (IJECCT) Volume 2 Issue 6 (November 2012).

[6] Yeong-Taeg Kim, *Contrast enhancement using brightness preserving Bihistogram equalization,* vol.43, no. 1, February 1997, pp.1-8.

[7] Y .Wang, Q. Chen and B.Zhang,Image *Enhancement Based on Equal Area Dualistic Subimage Histogram Equalization method*, IEEE Trans. on Consumer electronics vol.45, no. 1, February 1999, pp. 68-75.

[8] S-D.Chen, and A.Ramli, Minimum ,*Mean Brightness Error Bi-Histogram Equalization In Contrast Enhancement*, IEEE Trans. on Consumer Electronics, vol. 49, no. 4, November 2003, pp.1310-1319.

[9] Manpreet Kaur,Jasdeep Kaur, Jappreet Kaur, *Survey of Contrast Enhancement Techniques based on Histogram Equalizationfor scalable brightness preservation,* IEEE Trans. on Consumer Electronics, vol.49, no. 4, Nov 2003, pp.1301-1309.

[10] M.Abdullah-Al-Wadud, Md. Hasanul Kabir, M. Ali Akber Dewan, and Oksam Chae, *A dynamic histogram equalization for image contrast enhancement,* IEEE Trans.Consumer Electronics, vol.53, no. 2, May 2007, pp. 593-600.

[11] Haidi Ibrahim, and Nicholas Sia Pik Kong, *Brightness preserving dynamic histogram equalization for image contrast enhancement,* IEEE Trans Consumer Electronics, vol.53, no. 4, November 2007, pp.1752-1758.

[12] R C Gonzalez, R E Woods, *Digital Image Processing* 3rd Edition, Pearson Prentice Hall, 2004.

