

# Various Methods to improve the visual appearance of Black & White and Colored Images

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**ABSTRACT:** The aim of image enhancement is to improve the visual appearance of an image, or to provide a “better transform representation for future automated image processing. Many images like medical images, satellite images, aerial images and even real life photographs suffer from poor contrast and noise. It is necessary to enhance the contrast and remove the noise to increase image quality. Enhancement may be used to restore an image that has suffered some kind of deterioration due to the optics, electronics and/or environment or to enhance certain features of an image.

**KEYWORDS:** Frequency based domain enhancement, Image Enhancement, Spatial based domain enhancement. Dynamic Histogram Equalization

## I. Introduction:

Image Enhancement is the improvement of digital image quality, without knowledge about the source of degradation. Image Enhancement is the technique to improve the interpretability or perception of information in images for human viewers [1]. The main purpose of image enhancement is to bring out detail that is hidden in an image or to increase contrast in a low contrast image. Whenever an image is converted from one form to other such as digitizing the image some form of degradation occurs at output. Improvement in quality of these degraded images can be achieved by using application of enhancement techniques. Processing techniques for image enhancement can be classified into spatial domain enhancement and transform domain enhancement distribution.

## 2. Image Enhancement Techniques:

Various Image enhancement techniques can be divided into two broad categories:-

### 2.1 Spatial Domain Techniques:

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. In spatial domain for getting desired output the pixel values are manipulated [2]. Basically in spatial domain the

value of pixel intensity are manipulated directly as equation 1.1

$$G(x, y) = T[f(x, y)] \quad \text{----- (1.1)}$$

Where  $f(x, y)$  is input image,  $x, y$  is output image and  $T$  is an operator on  $f$ , defined over some neighborhood of  $f(x, y)$ . The approaches can be classified into three categories:

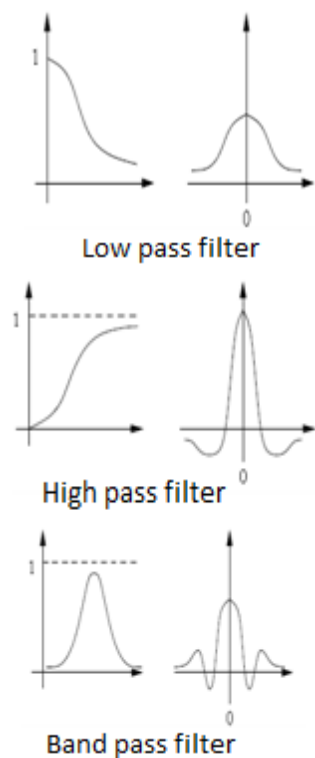
#### a) Point Processing operation:

Point processing operations (Intensity transformation function) is the simplest spatial domain operation as operations are performed on single pixel only. Pixel values of the processed image depend on pixel values of original image. It can be given by the expression  $g(x, y) = T[f(x, y)]$ , where  $T$  is gray level transformation in point processing.

#### b) Spatial filter operations:

It is deals with performing operations by working in a neighborhood of every pixel in an image. These are mask processing operations since they can take into account neighboring pixel intensities in the original image for computing the intensity value in the resulting image. Spatial filtering performs operations such as image sharpening, Noise reduction, edge enhancement. These filters can be linear or nonlinear. If the operation performed on the pixels is linear then the filter is called a linear filter otherwise it is a nonlinear filter. Linear filters are smoothing or low pass filter, sharpening filter, Laplacian filter, Un-sharp masking, and

High boost filter. Nonlinear filters are order statistic filters like Median filter, Max & Min filter.



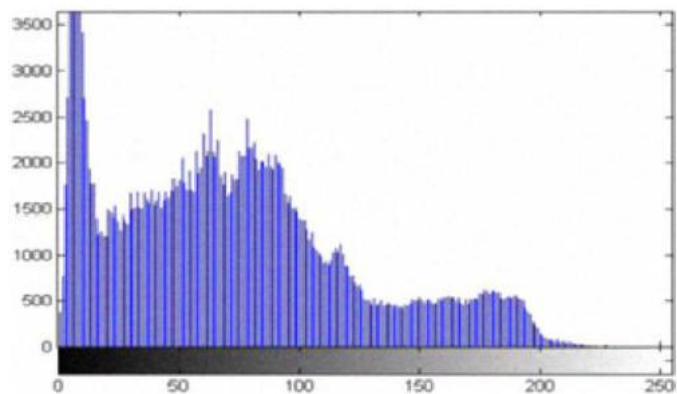
**Fig 1. Response of different types of filters**

**c) Histogram Equalization Algorithm:**

Histogram equalization (HE) is one of the image enhancement techniques in spatial domain which is considered to be most popular because of its simplicity and comparatively better performance on all types of images [3]. Histogram equalization is the technique by which the dynamic range of the histogram of an image is increased. It assigns the intensity values of pixels in the input image such that the output image contains a uniform distribution of intensities. It improves contrast and the goal of histogram equalization is to obtain a uniform histogram [8]. This technique can be used on a whole image or just on a part of an image. A histogram simply plots the frequency at which each grey-level occurs from 0 (black) to 255 (white). Histogram processing should be the initial step in preprocessing. To produce a much better image histogram equalization and histogram specification (matching) are two methods widely used to modify the histogram of an image. The histogram is a discrete function that is shown in figure 2.1 Histogram represents the frequency of occurrence of all gray-level in the image, that means it tell us how the values of individual pixel in an image are distributed. Histogram is given as-

$$h(r_k) = nk/N \quad \dots\dots\dots(2.1)$$

Where  $r_k$  and  $n_k$  are intensity level and number of pixels in image with intensity respectively.



**Fig 2. Histogram**

**2.1.1 Types of HE method for brightness preserving:**

This section describes three important image enhancement techniques which make use of the HE method with the purpose of brightness preserving.

**a) Contrast Limited Adaptive Histogram Equalization:**

This is an extension to traditional Histogram Equalization technique. It enhances the contrast of images by transforming the values in the intensity image  $I$ . Unlike HISTEQ, it operates on small data regions (tiles), rather than the entire image. The contrast, especially in homogeneous areas, can be limited in order to avoid amplifying the noise which might be present in the image.

**b) Equal Area Dualistic Sub-Image Histogram Equalization Method:**

This is a novel histogram equalization technique in which the original image is decomposed into two equal area sub-images based on its gray level probability density function. Then the two sub-images are equalized respectively. In fact, the algorithm can not only enhance the image visual information effectively, but also constrain the original image's average luminance from great shift. This makes it possible to be utilized in video system directly.

**c) Dynamic Histogram Equalization for Image Contrast Enhancement:**

It employs a partitioning operation over the input histogram to chop it into some sub histograms so that they have no dominating component in them. Then each sub-histogram goes through HE and is allowed to occupy a specified gray level range in the enhanced output image. Thus, a better overall contrast enhancement is gained by DHE with controlled dynamic range of gray levels and eliminating the possibility of the low histogram components being compressed that may cause some part of the image to have washed out appearance.

**2.2 Frequency Domain Techniques:**

Image enhancement techniques in frequency domain are based on modifying the Fourier transform of an image. In frequency domain methods, the image is first transferred in to frequency domain. It means that, the Fourier Transform of the image is computed first. All the enhancement operations are performed on the Fourier transform of the image and then the Inverse Fourier transform is performed to get the resultant image [6]. These enhancement operations are performed in order to modify the image brightness, contrast or the distribution of the grey levels. In the frequency domain The concept of filtering

is easier to visualize. Therefore, enhancement of image  $f(x, y)$  can be done in the frequency domain, based on its DFT  $F(u, v)$ . In the frequency domain the image enhancement can be done as follows:

$$G(u,v)=H(u,v) F(u,v)$$

Where  $G(u, v)$  is enhanced image,  $F(u, v)$  is input image and  $H(u, v)$  is transfer function. There are following basic steps are applied for filtering an image in frequency domain.

1. Compute  $F(u, v)$ , the DFT of input image.
2. Multiply  $F(u, v)$  by a filter function  $H(u, v)$   
 $G(u, v) = H(u, v) F(u, v)$ .
3. Compute inverse DFT of the result by applying inverse Fourier transform.
4. Obtain real part of inverse DFT.

The techniques that fall under this category include Low pass filtering, High pass filtering, Homomorphic filtering, Linear and root filtering. Homomorphic filtering is applied on low contrast images and the High pass filter is used as a surround function. The principle idea of Homomorphic filtering is to remove the illumination in the image. But this technique destroys some part of the image which does not require enhancement and that part is recovered using a threshold after applying Homomorphic technique [4]. Wavelet analysis has proven to be a powerful image processing tool in recent years. When images are to be viewed or processed at multiple resolutions the wavelet transform is the tool of choice [5].

### 3. Proposed Image Enhancement Methods:

#### 3.1 IPILP:

In digital image processing various techniques have proposed to enhance the quality of image such as histogram equalization, multi-histogram equalization and pixel dependent contrast preserving. Now we proposed a novel image enhancement technique “image pixel interdependency linear perceptron network (IPILP) for image enhancement that provides a better result for contrast enhancement with brightness preservation.

1. The proposed Image Pixel Interdependency Linear Perceptron Network (IPILN) technique uses Gaussian filter, curvelet transform and perceptron network. Basically our proposed technique involves three steps that are below.

- a) Image Filtration: The Gaussian filter is used to obtain a row image from input image.
- b) Image Transformation: Transformation is a process that is used to convert a signal from one domain to another without the loss of information. In our approach we are using a multi-resolution curvelet transform. To transform the row image, the curvelet transform is used that is a multidirectional transform.
- c) Perceptron Network: To adjust the weight of input image, the concept of perceptron network is used. In perceptron network to adjust the weight, the learning factor is used which vary from 0 to 1.

A simple block diagram of proposed method is shown in figure 3.

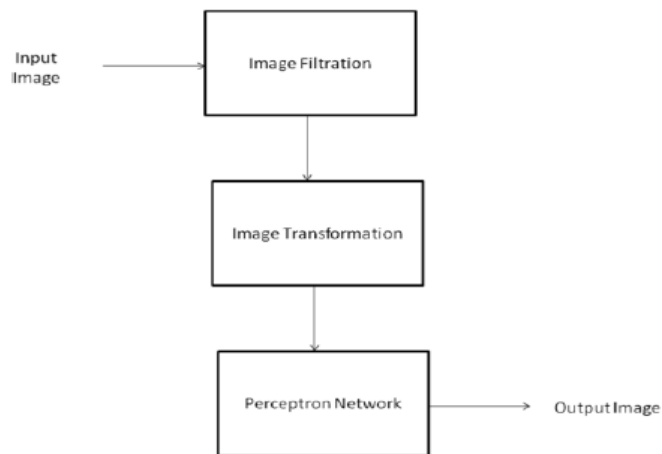


Fig 3. Block Diagram of Proposed method

#### 3.2 Image enhancement by Guided Image Filter & Wavelet Transform:

The proposed method is a combination of spatial domain method and wavelet domain method. In this proposed method, the noisy image is passed through guided image filter and some amount of noise gets reduced and the image become blur. Next the edge detection is performed. For that, the guided filter undergoes discrete wavelet transform. Form these coefficients, the edges are detected[7]. Finally, the spatial domain and wavelet domain methods are combined together to form the final denoised output.

##### 3.2.1 Guided Image Filter:

Guided image filter is an explicit image filter, derived from a local linear model; it generates the filtering output by considering the content of a guidance image, which can be the input image itself or another different image. Guided image filter has a fast and non-approximate linear-time algorithm, whose computational complexity is independent of the filtering kernel size. The guided filter output is locally a linear transform of the guidance image. This filter has the edge-preserving smoothing property like the bilateral filter, but does not suffer from the gradient reversal artifacts. Moreover, the guided filter has an  $O(N)$  time (in the number of pixels  $N$ ) exact algorithm for both gray-scale and color images. The guided filter performs very well in terms of both quality and efficiency in a great variety of applications, such as noise reduction, detail smoothing/enhancement, HDR detail smoothing/ enhancement, HDR compression, image matting/feathering and haze removal.

##### 3.2 Wavelet Transform:

The wavelet transform always offering great design flexibility while trying to replace standard image processing techniques [8], wavelet transforms provides an efficient representation of the image by finely tuned to its intrinsic properties. By combining such representations with simple processing techniques in the transform domain, multi resolution analysis can accomplish remarkable performance and efficiency for many image processing problems. Discrete non redundant wavelet analysis techniques. But after the transform plays a major role in image decomposition stage it introduces some artifacts. After wavelet decomposition, the horizontal edges of the images are present sub band HL sub band of the upper right quadrant. The vertical edges of the image can be similarly identified in the LH sub band of the lower left

quadrant. To combine this information into a single edge image, simply zero the LL sub band of the transform [9]. Then compute the inverse transform and take the absolute value.

#### 4. APPLICATIONS:

Image enhancement is used for enhancing a quality of images. The applications of image enhancement are Aerial imaging, Satellite imaging, Medical imaging, Digital camera application, Remote sensing, Image Enhancement techniques used in many areas such as forensics, Astrophotography, Fingerprint matching, etc. The better result for Image enhancement has also used in real time enhancement of neuron evolution of augmenting. IE techniques when applied to pictures and videos help the visually impaired in reading small print, using computers and television, and face recognition. Color contrast enhancement, sharpening and brightening are just some of the techniques used to make the images vivid. In the field of e-learning, IE is used to clarify the contents of chalkboard as viewed on streamed video; it improves the content readability. Medical imaging uses this for reducing noise and sharpening details to improve the visual representation of the image[10]. This makes IE a necessary aiding tool for reviewing anatomic areas in MRI, ultrasound and x-rays to name a few. In forensics IE is used for identification, evidence gathering and surveillance. Images obtained from fingerprint detection, security videos analysis and crime scene investigations are enhanced to help in identification of culprits and protection of victims.

#### CONCLUSION:

Image enhancement algorithms offer a wide variety of approaches for modifying images to achieve visually acceptable images. The choice of such techniques is a function of the specific task, image content, observer characteristics, and viewing conditions. Based on the type of image and type of noise with which it is corrupted, a slight change in individual method or combination of any methods further improves visual quality. It has been seen that modified DHE is an effective method of enhancing the images. All techniques which are implemented on Gray Scale images are also implemented by using RGB color model. It has been seen proposed method gave good result as compared to previous method. There is still a lot of research work going to reduce computational complexity as much as possible.

#### REFERENCES:

- [1] Raman Maini and Himanshu Aggarwal, "A Comprehensive Review of Image Enhancement Techniques", *Journal of Computing*, Vol. 2, Issue 3, March 2010, ISSN 2151-9617.
- [2] Chang Bu Jeong, Kwang Gi Kim, Tae Sung Kim and Seok Ki Kim, "Comparison of Image Enhancement Methods for Effective diagnosis in Successive Whole- Body Bone scans", *J Digital Imaging*, vol.24, no.1, June 2011, pp. 424-436.
- [3] Dileep.M.D, and A.Sreenivasa Murthy, "A Comparison between different Colour Image Contrast Enhancement Algorithms," *IEEE Proceedings of ICETECT*. 2011, pp. 708-712.
- [4] Sangjin Kim, Wonseok Kang, Eunsung Lee, and Joonki Paik, "Wavelet-Domain Color Enhancement using Filtered directional Bases and Frequency Adaptive Shrinkage," *IEEE Trans. on Consumer Electronics* vol.56, no. 2, May 2010.

[5] Dileep MD, A.sreenivasa Murthy, "A Comparison between different Colour Image Contrast Enhancement Algorithms", *ICETECT* 2011.

[6] Chen Hee Ooi, Nor Ashidi Mat Isa, "Quadrants Dynamic Histogram Equalization for Contrast Enhancement", *IEEE Trans, consumer electronics*, Vol. 56, No. 4, November 2010.

[7] Arun R, Madhu S. Nair, R. Vrinthavani and Rao Tatavarti. "An Alpha Rooting Based Hybrid Technique for Image Enhancement". Online publication in *IAENG*, 24th August 2011.

[8]. I. R. Terol-Villalobos, "A multiscale contrast approach on Morphological connected contrast mappings" *Opt. Eng.*, vol. 43, no. 7, pp. 1577-1595, 2009.

[9]. J. Kasperek, "Real time morphological image contrast enhancement in FPGA," in *LNCS*, New York: Springer, 2008.

[10] S. S. Aghaian, S. Blair and K. A. Panetta, "Transform coefficient histogram-based image enhancement algorithms using contrast entropy" *IEEE Trans. Image Processing*, vol. 16, no. 3, pp. 741-758, 2007.