Image Enhancement Techniques Pixel Operation in Spatial Domain

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***Abstract*--Image Processing includes image restoration, enhancement, coding, texture analysis, lossy and lossless data compression, filtering, segmentation and edge extraction etc. Principle objective of Image enhancement is to process an image so that result is more suitable than original image for specific application. This paper describes comparative study of various image enhancement techniques.**

Index-Terms--**Contrast enhancement, global, local enhancement, histogram equalization, Gamma correction.**

I. Introduction

IMAGE enhancement is the first step in image processing. The aim of image enhancement is to improve the interpretability or perception of on in images for human viewers, or to provide `better' input for other automated image processing techniques.

Image enhancement techniques can be divided into two broad categories:

1) Spatial domain methods, which operate directly on pixels, and

2) Frequency domain methods, which operate on the Fourier transform of an image.

Following are the different image enhancement techniques discussed in detail

1) Histogram Equalization (HE) and its variation

2) Image Enhancement by Unsharp Masking the Depth Buffer

Contrast Enhancement by Histogram Equalization and its variation.

Contrast enhancement has an important role in image processing applications. Numerous contrast enhancement techniques exist in literature, such as Gray Level Transformation based technique and Histogram Processing Technique.

HE - A perfect image is one which has equal no. of pixels in all its gray levels. Hence to get a perfect image our objective is not only to spread the dynamic range but also to have equal pixels in all the gray levels. This technique is known as Histogram Equalization. Histogram Equalization

processing is global method, in the sense that pixels are modified by transformation function based on gray level content of an entire image as shown in Fig. 1.

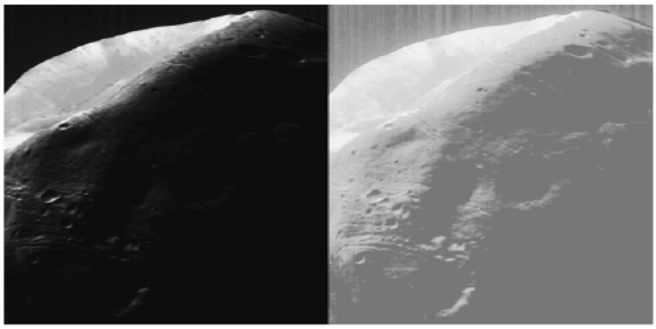

Fig. 1 Low Contrast Original HE result Image of Mars moon

Adaptive Histogram Equalization (AHE) –This is a local enhancement technique Mapping based on small overlapping areas of an image. There are the cases in which it is necessary to enhance details over small areas in an image. In AHE rectangular sub image of an input Image is first defined. Histogram of that block I obtained and Histogram Equalization function is determined. Finally processed sub images are represented together with bilinear interpolation. [1]

Contrast Limited Adaptive Histogram Equalization (CLAHE) - A generalization of AHE is CLAHE, has more flexibility in choosing local histogram mapping function. By selecting clipping level of the histogram undesired noise amplification can be reduced. In addition by method of background subtraction boundary artifacts can also be reduced. [6]

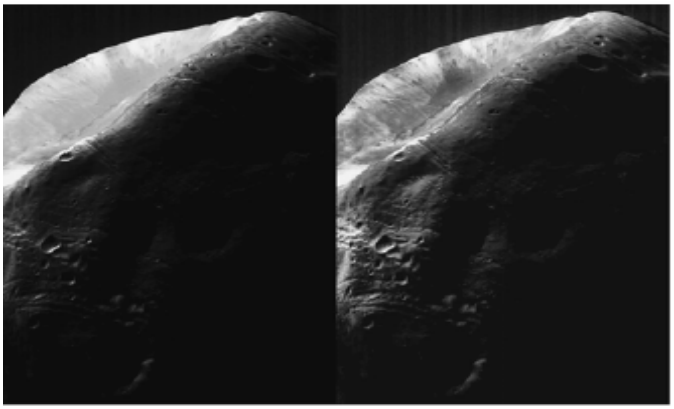

Fig. 2. Low Contrast Original CLAHE result Image of Mars moon

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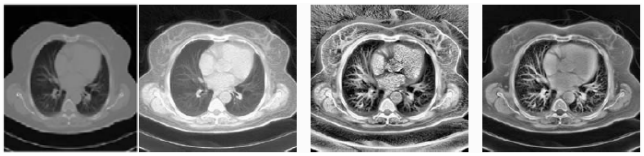
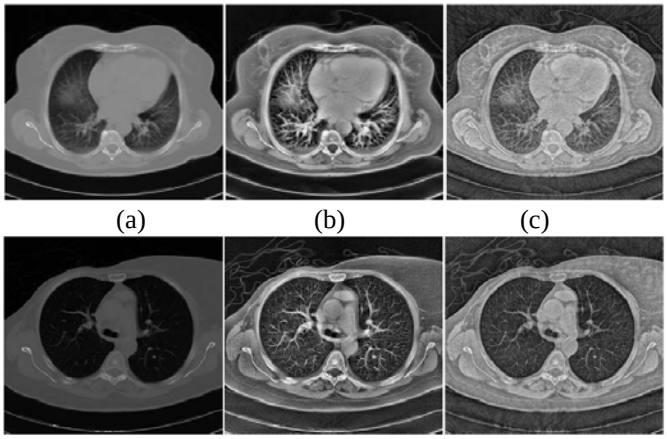


(a) (b) (c) (d)

Fig. 3 Contrast enhancement by traditional methods. (a) Original chest CT image, and enhanced images by (b) HE, (c) AHE, (d) CLAHE, respectively.

Multiscale Adaptive Histogram Equalization (MAHE)- This technique use multiscale analysis to decompose the image in to sub bands and apply corresponding enhancement technique to high frequency sub band and then combine the enhanced high frequency sub band with low frequency sub band to reconstruct the output image.[6]



(a) (b) (c)

(d) (e) (f)

Fig. 4 Results of two enhancement methods. Left column: Original image-(a) Bone lesion (d) bone lesion and nodules. Center column: CLAHE, Right column: MAHE

II. ALGORITHM

1) Apply histogram equalization to obtain uniform histogram of an image

2) AHE computes the histogram of a local window centered at a given pixel to determine the mapping for the pixel provide local contrast enhancement

3) Generalize AHE as CLAHE by selecting clipping level of histogram.

4) By applying MAHE selectively enhance the features of interest.

Image Enhancement by Unsharp Masking the Depth Buffer.

High pass filter gives great result but there is one problem, it gets rid of the complete background .When we need to enhance the edges but also need to retain some of the background we use modified version of high pass filter known as Unsharp Masking-USM (High boost filtering).

In High Boost filtering we pass some of the background along with the high frequency content

High pass = Original – Low pass. To pass some of the background multiply original image with multiplicative factor A. This gives us high boost filtering.

High Boost = (A) Original - Low pass

If A >1, some of the original signal is added back to high pass result. This process restores some of the background in to high passed image. This technique is known as Unsharp Masking.

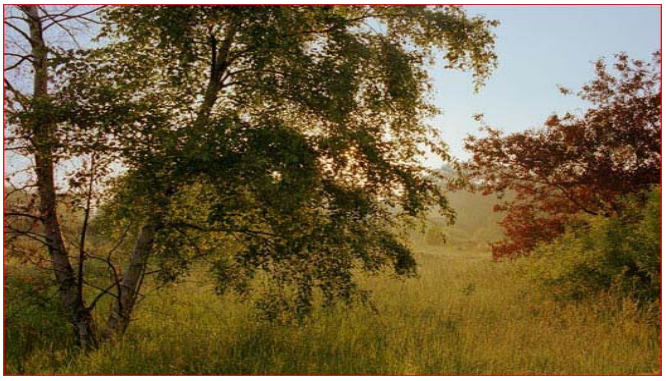


Fig. 5 Picture before applying USM

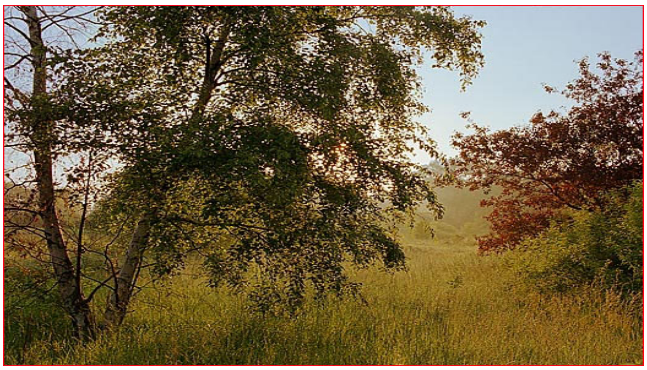


Fig. 6 Picture after applying USM

Fig.7 Image with less contrast

Fig.8 Image after USM

Unsharp Masking is a simple and efficient method to enhance perceptual quality of images containing depth information [7] as shown in Fig.9

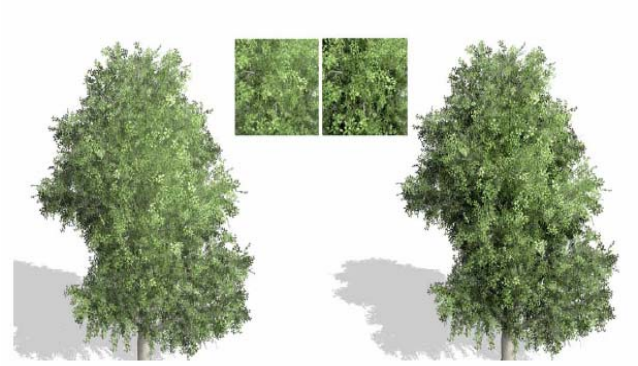


Fig.9 Enhancement of complex botanical object using depth darkening

III. ALGORITHM

Enhancement of images that contain depth information

1) The difference between original and low pass filtered depth buffer is computed in order to find spatially important areas. Apply unsharp mask as high boost filter.
2) Effect of depth darkening slightly darkens background objects by additional depth cues.
3) This information is utilized to locally enhance the contrast and color of image and perceptual recognition.

IV. CONCLUSION

MAHE method showed promising results on chest CT interpretation .Advantage of this method comes from combining local enhancement ability of AHE and selectivity of spatial frequency components from wavelet analysis

Unsharp mask depth buffer technique provides simple method for enhancing images that contain depth information. This information is utilized to locally enhance contrast and color of input image to improve the perceptual recognition.

V. REFERENCES

Books

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