Image Enhancement using a Combined Approach of Spatial and Transformation Domain Techniques

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Abstract:

Image enhancement is the task of applying certain alterations to an input image like as to obtain a more visually pleasing image. The alteration usually requires interpretation and feedback from a human evaluator of the output resulting image. Image enhancement is to improve the image quality so that the resultant image is better than the original image for a specific application or set of objectives. In this paper, there is a combined approach of gray level transformation algorithms, such as logarithmic transform and power law transform, with alpha rooting algorithm for contrast enhancement. Enhancement techniques such as alpha rooting operate on the transform domain where as grey level transformations operate on individual pixel. However, these techniques bring about tonal changes in the images and can also generate unwanted artifacts in many cases, as it is not possible to enhance all parts of the image in balanced manner.

Keywords— Image enhancement, spatial domain technique, Transform domain technique, alpha rooting, power law transformation, logarithmic transformation.

I. INTRODUCTION

Digital image processing is a broad subject and often involves procedures which can be mathematically complex, but central idea behind digital image processing is quite simple. The ultimate aim of image processing is to use data contained in the image to enable the system to understand, recognize and interpret the processed information available from the image pattern. Image enhancement is one of the important part of image processing. 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]. It is to improve the image quality so that the resultant image is better than the original image for a specific application. 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.

Image enhancement is among the simplest and most appealing areas of digital image processing. Basically, the idea behind enhancement techniques is to bring out detail that is obscured [2]. 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. The objective of image enhancement is dependent on the application context, and the criteria for enhancement are often subjective or too complex to be easily converted to useful objective measures, image enhancement algorithms tend to be simple, qualitative, and ad hoc. In addition, in any given application, an image enhancement algorithm that performs well for one class of images may not perform as well for other classes.

II. BACKGROUND

A. Spatial domain Techniques

The term spatial domain refers to the aggregate of pixels composing an image. Spatial domain methods are procedures that operate directly on these pixels. Spatial Domain processes will be denoted by the expression

$$g(x,y)= T[f(x,y)]$$

Where g(x,y) is an output image, f(x,y) is an input image and T is an operator on f (or a set of input images), defined over neighbourhood of (x,y).

B. Frequency domain techniques

Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. Frequency domain techniques are suited for processing the image according to the frequency content. The principle behind the frequency domain methods of image enhancement consists of computing a 2-D discrete unitary transform of the image, for instance the 2-D DFT, manipulating the transform coefficients by an operator M, and then performing the inverse transform. The orthogonal transform of the image has two components magnitude and phase. The magnitude consists of the frequency content of the image. The phase is used to restore the image back to the spatial domain. The usual orthogonal transforms are discrete cosine transform, discrete Fourier transform, Hartley Transform

etc.The transform domain enables operation on the frequency content of the image, and therefore high frequency content such as edges and other subtle information can easily be enhanced.

III. PROPOSED WORK

Many image enhancement techniques have been proposed. There are some drawbacks of these techniques. Histogram equalization produced over enhanced image. Adaptive histogram produces blurred and washed out images especially at the edges. Whereas alpha rooting produces over-graying enhanced images so to overcome all these drawbacks. Proposed method combining spatial enhancement techniques such as log transforms and power law transforms with alpha rooting in order to enhance the quality of the image. In these techniques each domain is having a basic nature, simplicity and ease of experimentation and at the same time being efficient also. Log transform and power law transform in the spatial domain account for techniques that are not complex but at the same time provide powerful enhancement. They were chosen especially for their power to map grey values across spectrum with the aid of parameters. Alpha Rooting holds the flexibility of a parameter aided operation which is highly appreciated for experimenting with different levels of enhancement. These techniques are not exhaustive in such an approach and further research could be carried out by substituting other techniques from the domain.
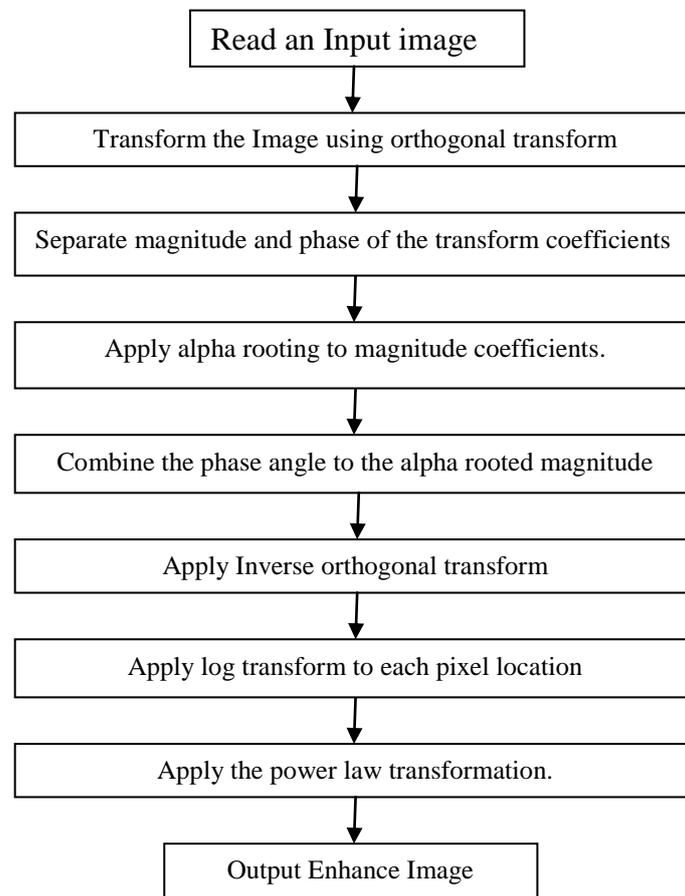
The proposed method flow following steps :

Read an Input image

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Transform the Image using orthogonal transform

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Separate magnitude and phase of the transform coefficients

↓

Apply alpha rooting to magnitude coefficients.

↓

Combine the phase angle to the alpha rooted magnitude

↓

Apply Inverse orthogonal transform

↓

Apply log transform to each pixel location

↓

Apply the power law transformation.

↓

Output Enhance Image

Fig1:- Steps of Proposed Method

IV. EXPERIMENTAL RESULTS

We see the experimental result on Beans.jpg image by using these hybrid techniques of frequency and spatial domain techniques of image enhancement.
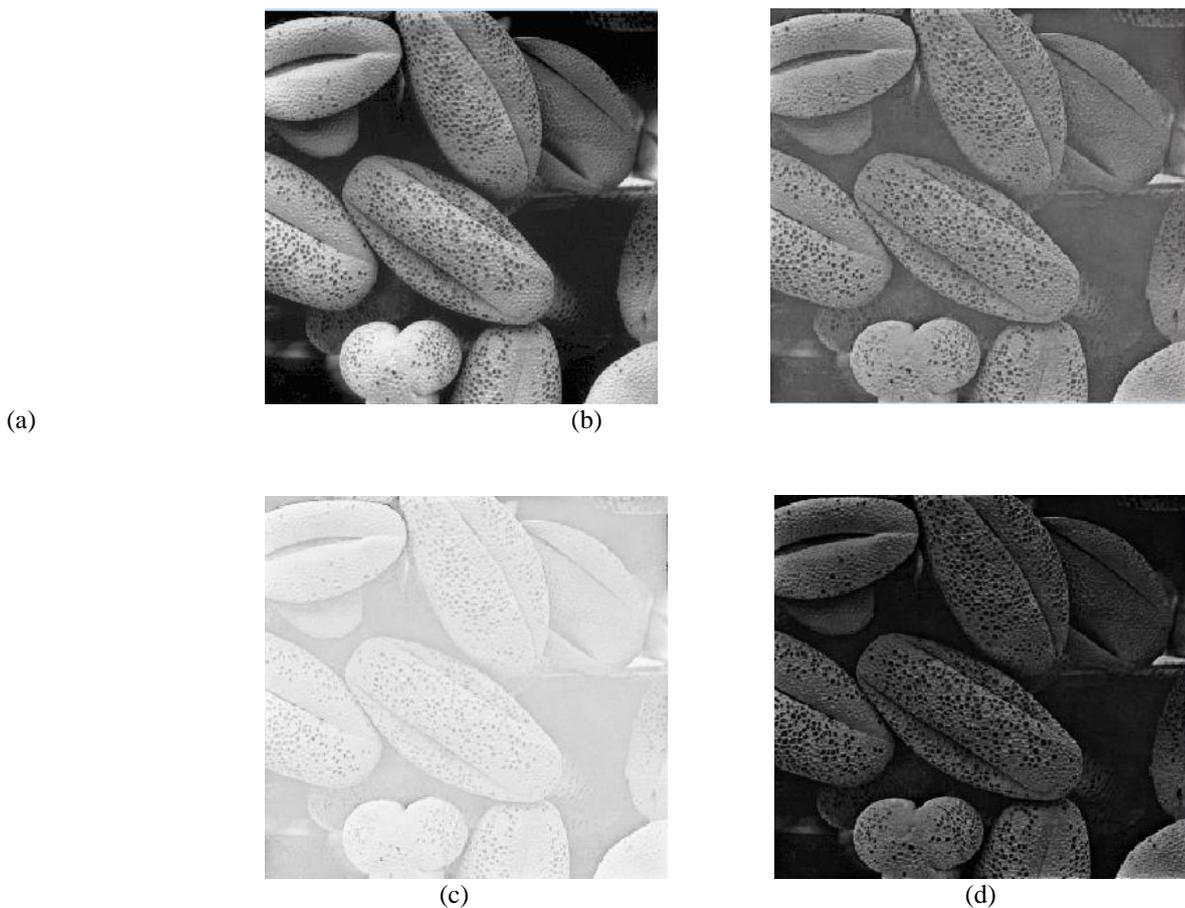
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Figure 2:- Result of "Beans" (a) Original Image (b) Alpha rooted Image (c) Log transform Image
(d)Combined Image by using spatial and frequency domain technique

V. CONCLUSION

Most of the techniques are useful for altering the gray level values of individual pixels and hence the overall contrast of the entire image. But they usually enhance the whole image in a uniform manner which in many cases produces undesirable results. There are so many drawbacks of various image enhancement technique to overcome this I have proposed hybrid technique by combining   the gray level transformation algorithms with alpha rooting algorithm for contrast enhancement. The proposed technique will produce highly balanced and visually appealing results for a diversity of images with different qualities of contrast and edge information and it will produce satisfactory result.

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