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Spatial and Transformation Domain Techniques for Image Enhancement

Snehal O.Mundhada, V. K.Shandilya
Student, A.P, Sipna College of Engineering and Technology, Amravati

Abstract*— 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. 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. Many images such as medical images, remote sensing images, electron microscopy images and even real life photographic pictures, suffer from poor contrast. Therefore it is necessary to enhance the contrast. The purpose of image enhancement methods is to increase image visibility and details. Two major classifications of image enhancement techniques are spatial domain enhancement and transform domain enhancement. 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.

***Index Terms*— Image Enhancement, Spatial Domain Technique, Transform Domain Technique, Alpha Rooting, Power Law Transformation, Logarithmic Transformation.**

I. INTRODUCTION

Digital image processing is an area characterized by need for extensive experimental work to establish the viability of proposed solutions to a given problem. One of part of the image processing is the image enhancement. Image enhancement processes consist of a collection of techniques that seek to improve the visual appearance of an image or to convert the image to a form better suited for analysis by a human or machine. 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. When pictures are converted from one form to another by processes such as imaging, scanning, or transmitting, the quality of the output image may be inferior to that of the original input picture [2].

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 [3]. 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. Current research in image enhancement covers such wide topics as algorithms based on the human visual system, histograms with hue preservation, JPEG-based enhancement for the visually impaired and histogram modification techniques. It is important to keep in mind that enhancement is a very subjective area of image processing [4] Improvement in quality of these degraded images can be achieved by using application of enhancement techniques. There are different types of noise that corrupt the image such as additive noise, Gaussian noise, impulse noise and Poisson noise etc to remove these types of noises there are various filters are available such as

- Gaussian filter
- Median filter
- High pass filter
- Low pass filter

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By using this filter noise can be removed and then we can get enhanced image. It is important to keep in mind that enhancement is a very subjective area of image processing. The principal objective of image enhancement is to modify attributes of an image to make it more suitable for a given task and a specific observer.

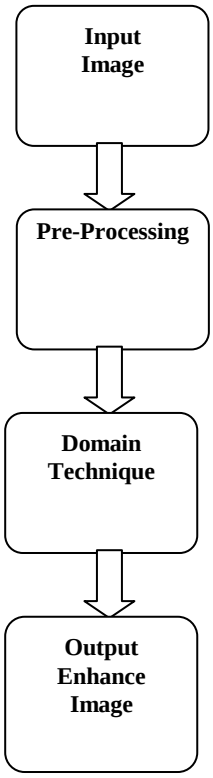

Fig 1:- Basic Steps of Image Enhancement

In figure the basic processing of image enhancement is explained. The steps are as follows

➢ Input image :-

In this first an image will be taken as an input. These images can be medical images, blur images, remote sensing images machine vision, the military applications etc.

➢ Perform preprocessing on the image :-

Images that will be taken as input can be blur image or noisy image so the various preprocessing methods will be performed on those images before applying enhancement technique.

➢ Applying Domain Techniques:-

After applying preprocessing method on input images then image quality will be enhanced by using Image enhancement domain techniques such as spatial or transformation.

➢ Output Enhanced Image:-

In this the output image will be get which is an enhanced image.

II. DOMAIN TECHNIQUES

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

A. Spatial Domain Techniques

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. Spatial domain techniques like the logarithmic transforms, power law transforms, histogram equalization, are based on the direct manipulation of the pixels in the image. Spatial techniques are particularly useful for directly 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 [5]. It is not possible to selectively enhance edges or other required information effectively. Now we see two techniques of spatial domain techniques.

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1. Log Transformation Technique

Log transformation is one of the elementary image enhancement techniques of the spatial domain that can be effectively used for contrast enhancements of dark images. The log transform is essentially a grey level transform which means that the grey levels of image pixels are altered. This transformation maps a narrow range of low grey level values in the input image to a wider range of output levels [1]. The general form of the log transformation can be mathematically represented as

$$s = c\ log(1 + r)$$

Where, s is the output grey level, r is the input grey level and c is a constant. It is assumed that $r \geq 0$.

2. Power Law Transformation Technique

Power law transformation is another commonly used gray level transformation in the spatial domain. It is conceptually similar to alpha rooting in the frequency domain as this is done by raising the input grey level by some power [6]. It is similar in operation to the log transforms in that power law transforms with fractional values of γ map a narrow range of dark input values into a wider range of output values thereby increasing the contrast. The transformation can represented as

$$s = br^{\gamma}$$

Where s is the output grey level, r is the input grey level, b is a scaling constant and γ is the power to which the input grey level is raised. One significant advantage of the transformation is that it is possible to control the transformation function by varying the parameter γ. The frequency domain of images is clearly depicted in the mathematical form as

$$X(p,s) = |X(p,s)|\ e^{j\theta(p,s)}$$

Where $X(p, s)$ is the orthogonal transform of the image, $X(p,s)$ is the magnitude of the transform and $\Theta(p, s)$ is the phase angle of the transform.

B. Transformation Domain Techniques

Transformation or frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. Transformation domain techniques are suited for processing the image according to the frequency content [1]. 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 [5]. 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. We see one technique of transformation domain i.e Alpha rooting technique.

1. Alpha rooting Technique

Alpha rooting is a simple but effective technique of image enhancement in the transform or frequency domain. The technique is applied on the orthogonal transforms of images. It is used to augment the high frequency content in the image. The method is based upon the fact that after applying an orthogonal transform, high frequency coefficients of an image, will have smaller magnitudes than low frequency coefficients. By raising the magnitude of an image to some value, α, where $0 < \alpha < 1$, the higher valued lower frequency components of an image can be reduced more in proportion to the lower valued high frequency components. The mathematical form of the operation is

$$X = |X(p,s)|^{\alpha}\ e^{j\theta(p,s)}$$

where $X(p,s)$ is the magnitude of the image transform, $\Theta(p, s)$ is the phase of the transform and α is the value by which the magnitude is raised $(0 < \alpha < 1)$.The effect is observable in most of the images on which alpha rooting is applied and becomes more pronounced in case of darker original images[4]. Thus many a time, the output image, although sharp, is unacceptably dark; it is poor in contrast and brightness expected of a good enhancement.

III. 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.

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IV. CONCLUSION

Image enhancement techniques such as spatial and transform domain technique are important techniques. 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 various techniques available which 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.

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] Komal Vij, Yaduvir Singh, "Comparison between Different Techniques of Image Enhancement" International Journal of VLSI and Signal Processing Applications, Vol. 1, Issue 2 , May 2011,(112-117) ISSN 2231-3133.

[3] Rajesh Garg, Bhawna Mittal, Sheetal Garg, "Histogram Equalization Techniques for Image Enhancement", IJECT Vol. 2, Issue 1, March2011, ISSN 2230-9543.

[4] Agaian, SOS S., Blair Silver, Karen A. Panetta, "Transform Coefficient Histogram-Based Image Enhancement Algorithms Using Contrast Entropy", IEEE Transaction on Image Processing, Vol. 16, No. 3, March 2007

[5] Arun R, Madhu S. Nair, R.Vrinthavani and Rao Tatavarti. "An Alpha Rooting Based Hybrid Technique for ImageEnhancement".Online publication in IAENG, 24thAugust2011.

[6] S.Jayaraman, S.Esakkirajan, T.Veerakima: Digital Image Processing, Ed III, Tata McGraw Hill Education private limited, New Delhi.

[7] Gonzalez, Rafael C., Richard E. Woods. : Digital Image Processing. Ed III, Pearson Education Asia, New Delhi, 2007.

[8] K.Arulmozhi, S.Arumug, Perumal, K.Kannan, S.Bharathi, "Contrast Improvement of Radiographic Images in Spatial Domain by Edge Preserving Filters", International Journal of Computer Science and Network Security, Vol.10 No.2, February 2010.

AUTHOR BIOGRAPHY

Snehal O. Mundhada received her B.E. degree from Sant Gadge Baba Amravati University, Amravati, India in 2009. This author is Pursuing M.E. in Computer Science & Engineering from Sant Gadge Baba Amravati University, Amravati, India

Prof. Vijaya K. Shandilya received her degree in CSE from VYWS College of Engineering badnera, Amravati, India, also received her Master of Engineering degree in CSE from badnera, Amravati. This author pursuing Ph.D. from Sant Gadge Baba Amravati University, Amravati, India. She is currently working as Associate Professor in the department of CSE Sipna's COET, Amravati. Her teaching experience is 14 years and 3 months.