International Journal of Electrical and Electronics Engineers
Vol. No. 9, Issue No. 02, July - December 2017
ISSN (O) 2321-2055
ISSN (P) 2321-2045

Image Enhancement with Respect to Resolution, Brightness and Contrast using Wavelet Transform and Singular Value Decomposition

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ABSTRACT

Many images in the field of image processing have poor quality with respect to resolution, contrast and brightness. Some of these fields are satellite images, images from medical image processing, general purpose images with poor light etc. Resolution is the smallest number of discriminable detail in an image. While contract is the ratio between brightest and the darkest pixel intensities. This paper proposes the enhancement of low contrast, low brightness and low-resolution images. This study is based on intensity transformation. The intensity transformation is achieved using histogram equalization on low frequency part from discrete wavelet transform (DWT) and the better illumination is achieved by singular value decomposition (SVD) technique. Sometimes this technique may be termed as singular value equalization.

Keywords: Singular Value Decomposition, Wavelet Transform, Image Enhancement.

I. INTRODUCTION

Image enhancement is the simplest and mostly desired area of digital image processing. The idea behind enhancement is to bring out the details in the image that are obscured and also to highlight certain features of interest in an image. Image resolution is always a key feature of all kinds of image.[*1]

Resolution has been frequently referred as an important aspect of an image. Images are being processed in order to obtain more enhanced resolution. Resolution is the detail an image holds. Poor resolution of an image is major issue in all image processing and video processing application like, feature extraction, video resolution enhancement and satellite image resolution enhancement. Higher resolution means more detail of an image.[*2]

Contrast of an image is determined by its dynamic range, which is defined as the ratio between brightest and the darkest pixel intensities. Preserving the edges is essential to increase the quality of the super resolved image.

In this study, Wavelet Transform has been employed in order to preserve the high frequency components of the image.[*3]For contrast enhancement singular value decomposition (SVD) is employed as, it allows us to re-factor an image with smaller set of values. It preserves useful features of original image, but uses less storage space in memory and achieves image compression.[*4,*5] But the proposed technique works for the quality of an image with respect to resolution, brightness as well as contrast simultaneously.

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II. OBJECTIVES OF THE STUDY

- To perform stationary wavelet transform on the image.
- To perform discrete wavelet transform on the histogram equalized image.
- To enhance vertical, horizontal and diagonal edges i.e. LH, HL and HH components using DWT and SWT.
- To apply Singular Value Equalization on obtained LL images to reconstruct new enhanced LL of image.
- To perform inverse discrete transform on all enhanced LL, LH, HL, HH images.
- To compare qualitative and quantitative performance of proposed algorithm for various images.

III. LITERATURE SURVEY

This section presents existing literature, similar researches, and the steps they followed in their systems, and the techniques they used in each step.

Tarik Arici, SalihDikbas and YucelAltunbasak [2009] proposed a protocol which uses histogram equalization for image contrast enhancement is presented. Contrast enhancement minimizes cost function. The method histogram equalization is an efficient method for contrast enhancement. Conventional histogram equalization (HE) gives desirable contrast. The image has an unnatural look and creates visual artifacts. It will enhance the level of contrast and can the noise robustness, white or black stitching and mean-brightness preservation.[*6]

Hasan Demirel [2010] proposed technique which uses a new satellite image contrast enhancement technique that is based on the discrete wavelet transforms (DWT) and singular value decomposition. The Discrete Wavelet Transform is the technique that captures both low frequency coefficient and high frequency coefficient of an image and it decomposes the input image into the four frequency sub bands and estimates the singular value matrix of the low- low sub band image after that the image get deconstructed by inverse DWT. Standard general histogram equalization and local histogram. The techniques such as brightness preserving dynamic histogram equalization and singular value equalization prove the better equalization[*7.]

Hasan Demirel, GholamrezaAnbarjafari and Mohammad N. SabetJahromi [2008] proposed the novel image equalization technique which is based on singular value decomposition (SVD). The singular value matrix represents the intensity information of the image and any change in the values of singular matrix changes the intensity of the image. This technique converts the input image into the SVD domain. Then then normalization is performed on the singular value matrix to get new singular value matrix. In reconstruction process, new singular value matrix is used to reconstruct the image in the spatial domain. This process is called as singular value equalization (SVE). It gives better results in comparison with grayscale histogram equalization (GHE) method.[*8]

IV. PROPOSED SYSTEM

Block diagram of proposed technique is shown in figure 1. In first step, resolution enhancement uses the DWT and SWT, and in second step Brightness and contrast is enhanced by using singular value equalization using SVD and DWT.

The image resolution enhancement is done enhancing high frequency sub-band images obtained by discrete wavelet transforms (DWT). The edges of an image are enhanced by introducing an intermediate stage by using

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stationary wavelet transform (SWT) and interpolated version of LH, HL, HH sub-bands of DWT transformed input image. DWT is performed to decompose an input image into LL, LH, HL and HH sub-bands. The high frequency sub-bands (LH, HL and HH) of DWT are modified by using high frequency sub-band obtained through SWT.

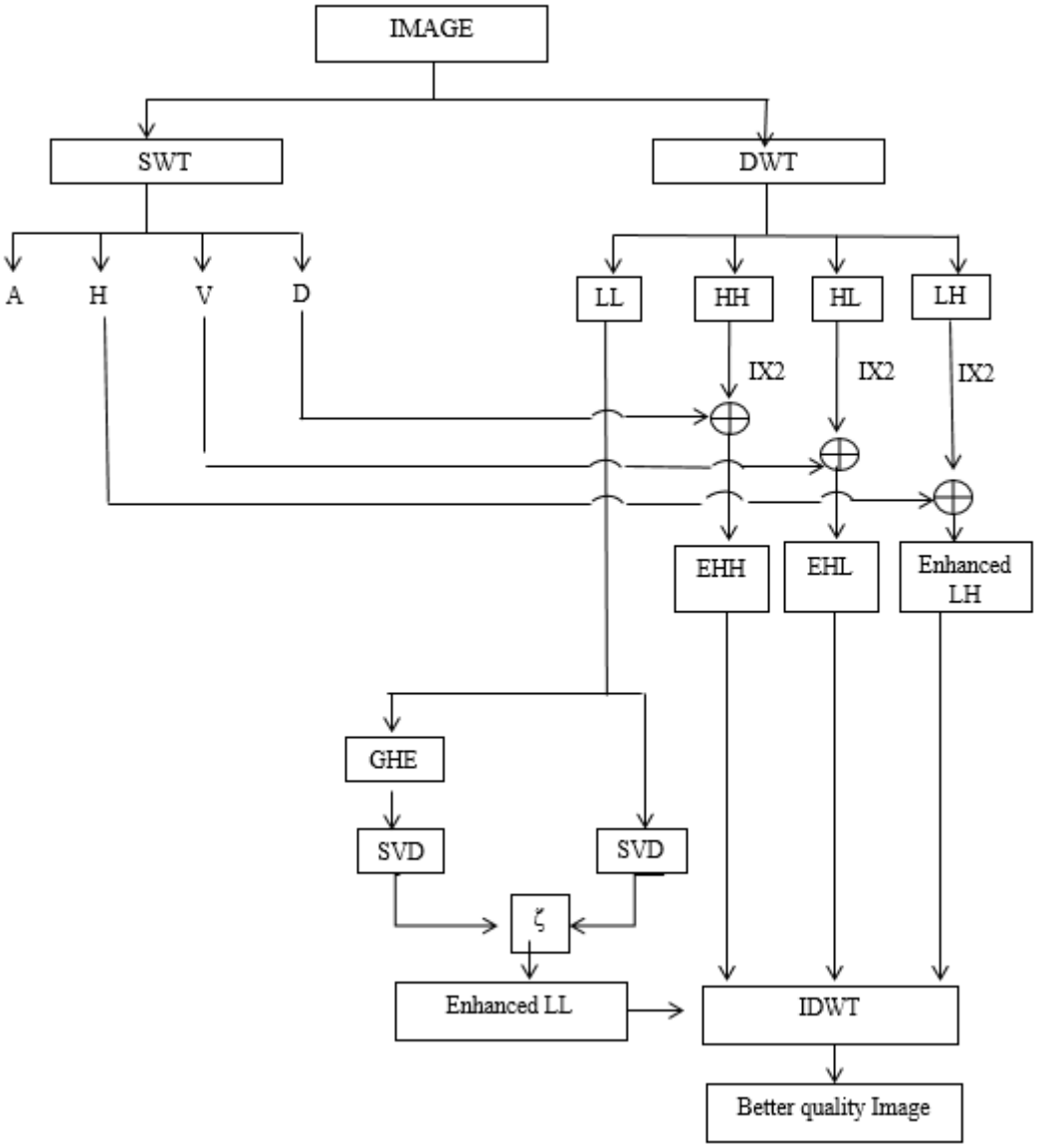

Figure 1: Proposed System

The brightness and contrast is enhanced by applying singular value equalization on LL component of DWT. LL component coarse approximation of an image. It contains most important intensity information or low frequency information of an image.

Firstly, we apply SVD on LL component obtained from DWT of input image. Then applying parallelly the histogram equalization at LL component followed by SVD of histogram equalized image.

The zeta factor is obtained from the ratio maximum value of illumination component obtained from SVD's ofLL component and GHE transformed LL component. Multiplying SVD of LL component with factor zeta will give new enhanced illumination component. By performing inverse SVD on new enhanced LL component we will get enhanced LL component.

Finally, by performing inverse discrete wavelet transform on enhanced LL, enhanced LH, enhanced HL and enhanced HH we will get high resolution, brightness and contrast equalized image.

V. RESULTS

		
Original Test Image 1	**Histogram Equalized Image 1**	**Enhanced Image 1**
		
Original Test Image 2	**Histogram Equalized Image 2**	**Enhanced Image 2**

VI. CONCLUSION

The proposed image enhancement technique enhances the resolution, brightness and contrast of an image very well. This is due to the wavelet transform is well known for its denoising ability and multispectral resolution enhancement. Here discrete wavelet transform and stationary wavelet transform are used to preserve the high frequency components of an image. The brightness of image is enhanced by using discrete wavelet transform (DWT) and singular value decomposition (SVD). While contrast is enhanced by using singular value equalization. Visual result shows the superiority of proposed algorithm.

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