

A Novel Approach on Image Enhancement Using DWT-SVD

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Abstract : Image enhancement is most significant step of the digital image processing. Image enhancement is done to improve the images for better perception. There are many ways of improving the images. Basically, these image enhancement are divided into 2 types: Spatial Domain and Frequency Domain. In this enhanced method, LPF coefficients of wavelets and their scaled type undertake masking approach. These scale value is acquired using SVD between rebuilded the estimate coefficients and standard intensity deviation based on sub band HE image. The hiding image is added to the inventive image to get a high contrast-enhanced image. The advantage of the proposed method tested over other methods. The quality and valued analysis is used to give reason for the presentation of the proposed method. A proposal of the image enhancement technique based on frequency domain method. Resolution is most important value factors in images. In this paper we taken Discrete Wavelet Transform to change the input image into the four equal frequency sub-bands and for the LL sub band we estimate the singular value of the image. Then, this output image is rebuilded by applying Inverse Discrete Wavelet Transform. This method determines the singular value matrix using SVD. The low-low sub band of histogram equalized image changes singular value matrix to obtain brightness enhanced image.

I. INTRODUCTION

Images are important because they provide information. Images are useful in different fields like agriculture, geology, forestry, weather forecast and education. But frequently these images are blurred or have low intensity values. The impure image sensors add noise to the captured images. There are separate types of noise like Gaussian noise which is additive noise, which is multiplicative noise. The unsatisfactory enlightenment is also liable for degradation of the images. So there is possibly will to do with of image enhancement for better interpretation of the images. The image enhancement is important step of digital image processing. It is used to get good perception of the images and used to highlighting particular part of the images. The following figure 1 shows image enhancement[1].



Fig: Image Enhancement

There are various types of image enhancement techniques. The image enhancement methods are mainly divided into 2 types:

- Space domain
- Frequency domain

Here we are using frequency domain for Frequency Domain: In this technique, Fourier Transformation concept is used. The transformation is done orthogonally of the image is done. The concept which is used in the frequency domain consists the computation of a 2-D discrete unitary transform of the image, for instance the 2-D DFT, operating the transform coefficients by an operator M , and then performing the inverse transform. If the transformation is orthogonaled of the image, phase and direction. In this section we are introducing the image enhancement, DWT, SVD, Resolution Enhancement, Brightness Enhancement. In section II, parameters of the image enhancement has been discussed. In section III, we are discussing about the proposed method. In section IV, we concluded about this project.

1.1. Image Enhancement:

The main purpose of this method is to improve the capable of being explained of the information present in images for human viewers. An enhancement result is one that yield a better satisfactory image for the purpose of some particular application which can be done by either suppressing the noise or increasing the image contrast. These results are employed to emphasize, sharpen or polished image features for display and analysis. Enhancement methods are application specific and are often established worldwide. Image enhancement techniques highlight certain image features to improve the visual perception of an image. The motive of this is to get better quality image for a certain field by increasing the given image quality. Image contrast enhancement is an important technique in image processing for better human perception and computer vision. It is one of the quality measurements of the image, which is defined as the difference in intensity between highest and lowest intensity levels in an image. In the images with low contrast, all information is intense over a small range resulting loss of information in the remaining areas. To represent all provided things there in an image contrast improvement is needed. The high contrast image has high dynamic range with more gray level details. There exist different methods in literature for image contrast enhancement magnitude is included.

1.2. Discrete Wavelet Transform:

Discrete wavelet transform became a very adaptable signal processing tool that was developed by the scientist Mallat proposed the MR of the signals that decomposes the wavelet. It allows the analysis of both spatial and frequency domains of the signals. The DWT decomposes the signals into separate subbands have final frequency resolution compare to the higher frequency subbands.

Image Enhancement in the wavelet domain is a relatively new research addition, and recently, many new rules and others have details at the unknown details of wavelet coefficients in an effort to improve the sharpness of rebuilt images. The 1-D Transform can be developed to 2-D transform using separable wavelet filters. With separable filters, a 1-D transform is all the applied to the rows of the input and these was repeated on all of the columns that can compute the 2-D transform. Then four transform coefficient sets are created of applying the one-level of 2D-transform. The LL, HL, LH, and HH represents four sub-bands where the first letter corresponds to a low or high filter to the rows and the second letters refers to the filter applied to the columns.

The disintegration of images into different frequency ranges allows the segregation of the frequency into certain sub-bands. This process results in separating small changes in an image mainly in low frequency sub-band images. The 2D wavelet transformation of an image is accomplished by applying 1D Discrete Wavelet Transformation along the rows of the image first, and, then the columns. This disintegration results in four divided sub-band images referred to as low-low (LL), low-high (LH), high-low (HL), and high-high (HH) as shown in fig.2

The Fig.3 shows the LL, LH, HL and HH sub-bands of the building image. Here, the rebuilt LL sub-band intensity particulars are used to get the best output along with the input image. The remaining sub-bands have edged figures and details of the image as it contains high frequency. The clarification improvement can be achieved by scaling the coefficients of the LL sub-band.

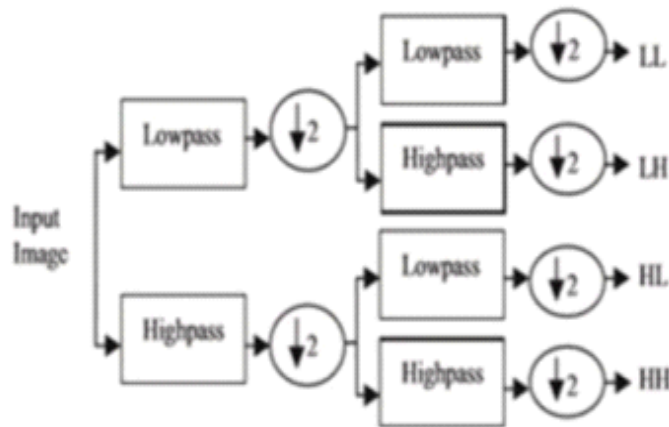


Fig 2: Block Diagram of DWT

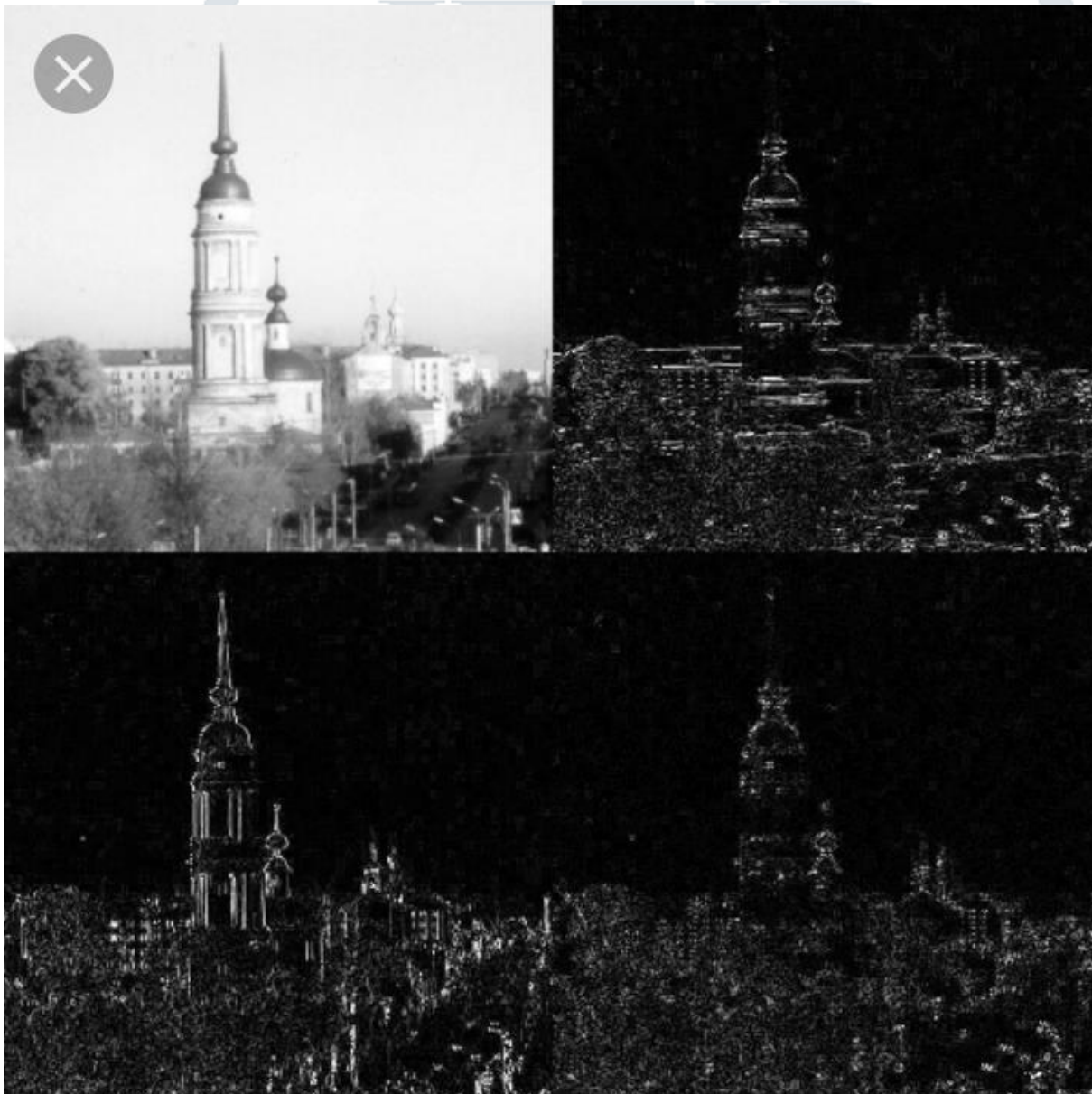


Fig 3: Image of a Building (a)LL sub-band (b) LH Sub-band (c) HL sub-band (d) HH sub-band

1.3. Singular Value Decomposition (SVD):

SVD is based on a theorem from linear algebra which says that a rectangular matrix A , which is a product of three matrices that is (i) U_a is an orthogonal matrix, (ii) ΣA is a diagonal of a matrix and (iii) V_a is the transpose of an orthogonal matrix. The singular value equalization method is based on equalizing the

singular value matrix obtained by singular value decomposition (SVD). SVD of an image, is written as follows:

$$A=U_A \Sigma_A V_A^T \quad (1)$$

Basic enhancement happens due to ascending of singular values of the DCT coefficients. The singular value matrix represents the intensity particulars of input image and the input image changed by the singular values. The image equalization is the major advantage of the SVD, Σ_A contains the intensity information of the image. Singular value decomposition (SVD) is a technique used to diagonalize matrices in numerical analysis [3,4]. It has an ability to manipulate the image in base of two distinctive subspaces data and noise subspaces, which is usually used in noise filtering and also was utilized in watermarking applications[9,6]. Each of these applications utilizes key properties of the SVD. Also it is mainly used in getting outputs of least squares problem, pseudo-inverse of a matrix and multivariate analysis.

1.4. Brightness Enhancement:

In Brightness Enhancement method, at first apply Discrete Wavelet Transform to the output of first part, and then calculate the singular value of LL sub-band image using SVD. Then applying parallel the histogram equalization at the high resolution image. HE is a process automatically determining transformation function which produce an output image with a equal histogram. Apply DWT to the histogram equalized image, it gets different sub-bands. Then calculate the singular value LL bands using SVD. The singular value matrix obtained by SVD contains the enhanced information. To change the brightness of the image, we are changing this matrix. Any changes made to this matrix will not change the other features of the image. Combining the two SVD output will produce new LL band is given by

$$LL \text{ (new)} = U \Sigma^T \quad (2)$$

Where $m \times m$ real unitary matrix is U , $m \times n$ rectangular diagonal matrix is Σ which contains the enlightenment information of an image, and V^T is an $n \times n$ real or complex unitary matrix. Then applying the inverse DWT. IDWT has been applied to add all these images to get the final brightness enhanced image.

1.5. Resolution Enhancement:

It is an important feature in all image processing techniques, which makes the resolution enhancement of such images, will directly influence the production of the system using these images as input. The image after being resolution enhanced by applying interpolation is on its high frequency components, which is due to smoothing caused by interpolation, is the main disadvantage. Hence, in order to increase the quality of the enhanced image, preserving the edges is required. To preserve the high frequency components of the image, we are applying the DWT to the system.

The information loss in the respective sub-bands occurs by applying down-sampling of the DW T. so those can be minimized by using SWT along with DWT. In the proposed method, input image is interpolated images. The interpolated high frequency sub-band and the SWT sub-band are added with each other. The new corrected high frequency sub-band can be interpolated with factor $\alpha/2$ for higher enlargement. The low-frequency sub-band image, which contains less information than the original input image, so we are using this input image through the interpolation process.

The high frequency sub-bands and interpolated input image are combined by using inverse DWT, to produce the high resolution image.

II. PARAMETERS USED FOR MEASURING EFFECTIVENESS OF IMAGE ENHANCEMENT TECHNIQUES :

The important of the image enhancement techniques can be measured in terms of some parameters are:

2.1 Mean Square Error: MSE represents cumulative squared error between the enhanced and original image.

2.2 Peak Signal to Noise Ratio (PSNR): In PSNR, peak error has to be measured [4].

It can be defined $PSNR = 10 \log_{10} (R^2 / MSE)$ (6)

2.3 Bit Error Rate (BER): Bit error rate is defined as the ratio of how many bits received in error to the total number of bits received.

2.4. Mean: Mean is the average of all intensity value [4]. It is denoting the average brightness of the image.

2.5. Standard Deviation: Standard Deviation is denoting the deviation of the intensity values about mean [6].

III. Proposed Method:

The image resolution enhancement technique is proposed based on high frequency sub-band images obtained by discrete wavelet transforms (DWT) of the interpolated input image. The edges are enhanced by recognized an intermediate stage by using stationary wavelet transform (SWT).

To decompose an input image into different sub-bands, DWT is applied. The high frequency sub-bands obtained through the SWT can modifies the high frequency sub-bands of the DWT. Then all these sub-bands are added to get a inverse DWT which gives high resolution image. To increase the brightness of the image, use SVD and DWT at the output of the resolution enhanced image. In this method of resolution enhancement DWT using wavelet as a mother wavelet function and bicubic interpolation as interpolation technique.

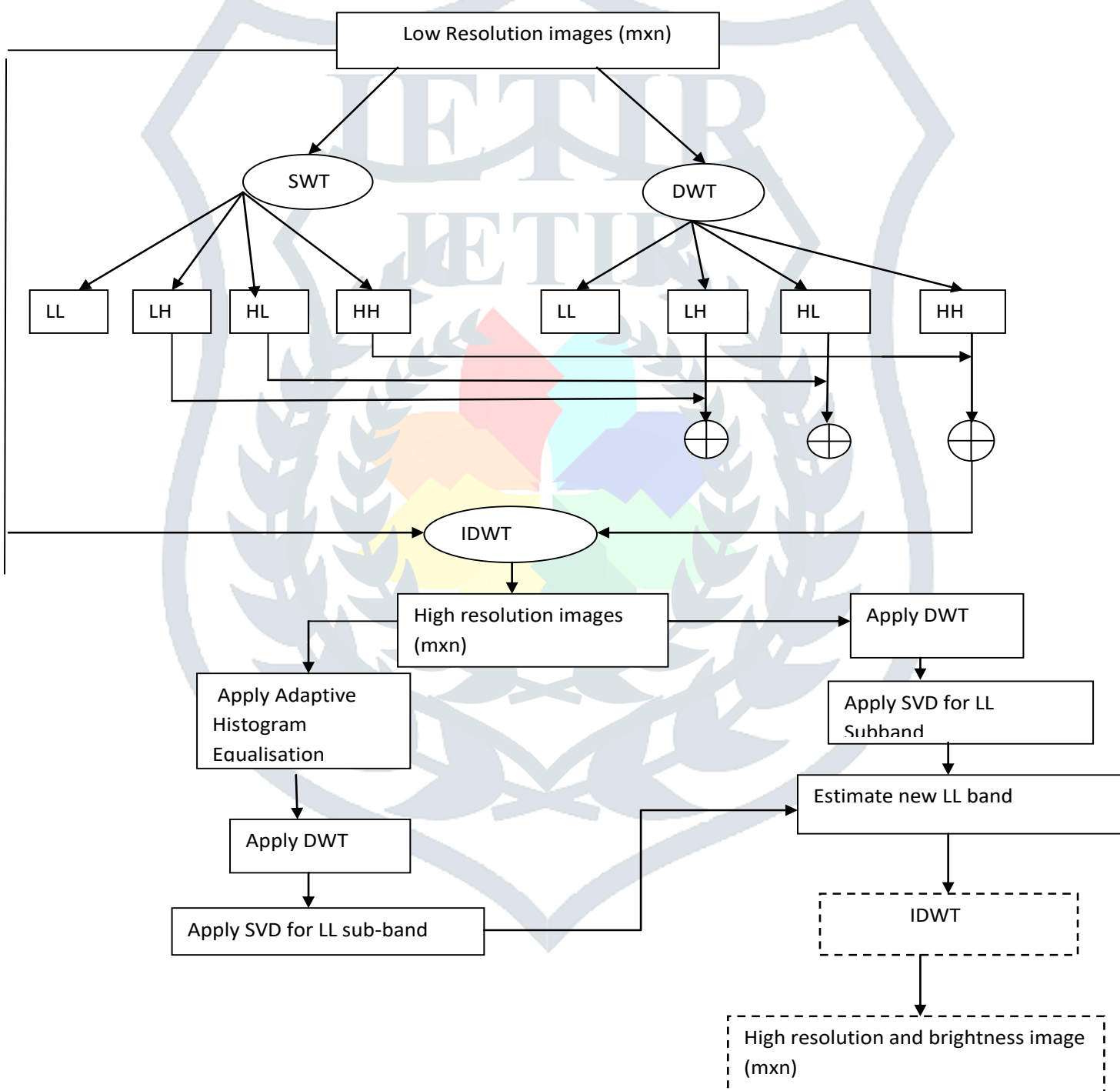


Fig: Block diagram of proposed method

IV. Conclusion:

Image enhancement is necessary for making the images more interpretable so that maximum information should be obtained from them. In this paper, we tried to develop a method that improves the image contrast enhancement. The DWT is shift variant that does not consider the problem of noise enhancement. The SVD method helps to modify the intensity information and it is used to calculate the scale value. . In the Frequency domain techniques, certain features may be introduced in the images after enhancement of the image.

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