Advanced Method for Image Resolution Enhancement

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Abstract –*High resolution images decide the performance of system. Image resolution enhancement is process to increase no of pixels. In this we increase quality of image to make it suitable for all applications. In the proposed method we have used combination of DWT, SWT & Interplarion i.e.combination of 3 traditional methods. DWT is having edge loss problem so along with it SWT is used to overcome edge loss problem. Initially dwt of low resolution image is taken. The LL band of this is interpolated by factor of 2 & it is combined with SWT of input low resolution image. Again inverse DWT is taken of resultant image. This method is tested on standard benchmark images & giving better results as compared to traditional methods.*

***Key Words*: Image1, wavelet2, PSNR 3, Resolution 4**

1. INTRODUCTION

Image resolution enhancement is one of the most common methods of low-level digital image processing. Digital image processing field defines the treatment of digital images by means of a digital computer. A process of low-level enhancement has both its inputs and outputs as images. Image resolution is vital aspect.

Resolution means clear appearance of image to the user. Image processing (Image Resolution Enhancement) has many applications in the field of Medical, Satellite Image Processing, Industrial applications. Image resolution enhancement includes improving quality of image by increasing number of pixels, so that the image is more suitable for any applications. The main objective of enhancement is to increase quality of image. The aim of image enhancement means adopting some technical method, which includes algorithm, to stand out the interested characteristics of the image and to restrain some useless characteristics of the image. The image, which has been improved, can satisfy some special analysis better than the original one. It is the process of manipulating an image so that resultant image is more suitable than the original one for specific application.

2. MOTIVATION

In the recent years there is increase in the demand for better quality images in the various applications such as medical, astronomy, object recognition. Image resolution enhancement is also widely useful for satellite image applications which include building construction, bridge recognition, in GPS technique. For image enhancement process there are two domains has been taken into consideration one is image domain and transform domain. Image interpolation is widely used resolution enhancement method for various applications. The first used method is interpolation. In this the complexity of system increases as interpolation factor is increased. So images are studied in different domains.

Discrete wavelet transform (DWT) is basic [11] wavelet transform.

The Discrete Wavelet Transform is not a time- invariant transform. The way to restore the translation invariance is to average some slightly different DWT, called decimated DWT, to define the stationary wavelet transform (SWT).The Stationary wavelet transform (SWT) is a wavelet transform algorithm designed to overcome the lack of translation-invariance of the discrete wavelet transform (DWT). Translation invariance is achieved by removing the down samplers and up samplers in the DWT and up sampling the filter coefficients. The SWT is an inherently redundant scheme as the output of each level of SWT contains the same number of samples as the input, so for a decomposition of N levels there is a redundancy of N in the wavelet coefficients. Hasan Demirel and Gholamreza Anbarjafari propose an image resolution enhancement technique based on interpolation of the high frequency sub-band images obtained by discrete wavelet transform (DWT) and the input image. The edges are enhanced by introducing an intermediate stage by using stationary wavelet transform (SWT). In this correspondence, one level DWT (with Daubechies 9/7 as wavelet function) is used to decompose an input image into different sub-band images.

Another transform is stationary wavelet transform (SWT) [7]. The Discrete Wavelet Transform is not a time- invariant transform. The way to restore the translation invariance is to average some slightly different DWT, called decimated DWT, to define the stationary wavelet transform (SWT). Let us recall that the DWT basic computational step is a convolution followed by decimation. The decimation retains even indexed elements. But the decimation could be carried out by choosing odd indexed elements instead of even indexed elements. This choice concerns every step of the decomposition process, so at every level we chose odd or even. It does so by suppressing the down-sampling step of the decimated algorithm and instead up-sampling the filters by inserting zeros between the filter coefficients.

3. PROPOSED METHOD

The proposed technique uses combination of DWT, SWT & Interpolation to enhance low resolution image to high resolution image. The brief steps in the method are Step 1: Take standard bench mark high resolution image(say 512×512) .

Step 2: Down sample the high resolution image 2 times by using DWT. In this project, discrete wavelet transform algorithm is designed using Haar wavelet function for DWT decomposition & IDWT. Obtained low resolution image is of size 128 × 128.

Step 3: Apply 1 Level 2 Dimensional Discrete wavelet transform to obtained low resolution image of size 128 × 128. DWT decomposes the low resolution image into 4 sub-bands (say a, h, v, d).These are representing LL, LH, HL & HH respectively. In DWT size of a, h, v, d is down-sampled by 2.i.e. its size is 64 × 64. In the proposed technique, 3 high frequency sub-band images of DWT have been interpolated using bi-cubic interpolation by factor of 2.Then it's size becomes 128× 128. (we get newh, newv, newd) .

Step 4: Apply 1 Level 2 Dimensional Stationary wavelet transform to obtained low resolution image of size 128 × 128. SWT decomposes the low resolution image into 4 sub-bands (say a1, h1, v1, d1).These are representing LL,LH, HL & HH respectively. In DWT size of a, h, v, d is down-sampled by 2.i.e. its size is 64 × 64. In SWT, size remains same (128 × 128). It is not down-sampled.3 high frequency sub-bands of SWT are added with interpolated high frequency sub- band images of DWT. Add h1, v1, d1 with newh, newv, newd to get corrected sub-bands.

Step 5: These corrected sub-bands & input image are again interpolated by factor of α/2. Here α is enlargement factor. example 128× 128 image is enhanced to 512×512,here α=4. Here input image is taken in stead of considering LL band because low resolution images are obtained by down-sampling the high resolution image, so the input image can be treated as low frequency band of high resolution output image.

Step 6: These interpolated bands & interpolated input image in step 5 are combined through IDWT to obtain high resolution image at output. This obtained image preserves the edges (high frequency components). In order to show the effectiveness of the proposed method over the conventional and state-of-art image resolution enhancement techniques, four well-known test images (Lena, Elaine, Baboon, and Peppers) with different features are used for comparison. The quantitative (peak signal-to-noise ratio and root mean square error) and visual results show the superiority of the proposed technique over the conventional and state-of-art image resolution enhancement techniques. The high resolution image is down-sampled to obtain low resolution image & the obtained low resolution image is enhanced by using proposed method. The quantitative (Peak signal to noise ratio) and visual results are superior over conventional image resolution enhancement techniques.

4. Results & Discussions

For Proposed method has been tested with standard set of test gray images & color images. The image enhancement is carried out in following steps.

1) The high resolution standard bench mark input images (size 512×512) are taken.

org Image

2)These high resolution input images are down sampled to 128 × 128 & low resolution images are obtained.

Input Image

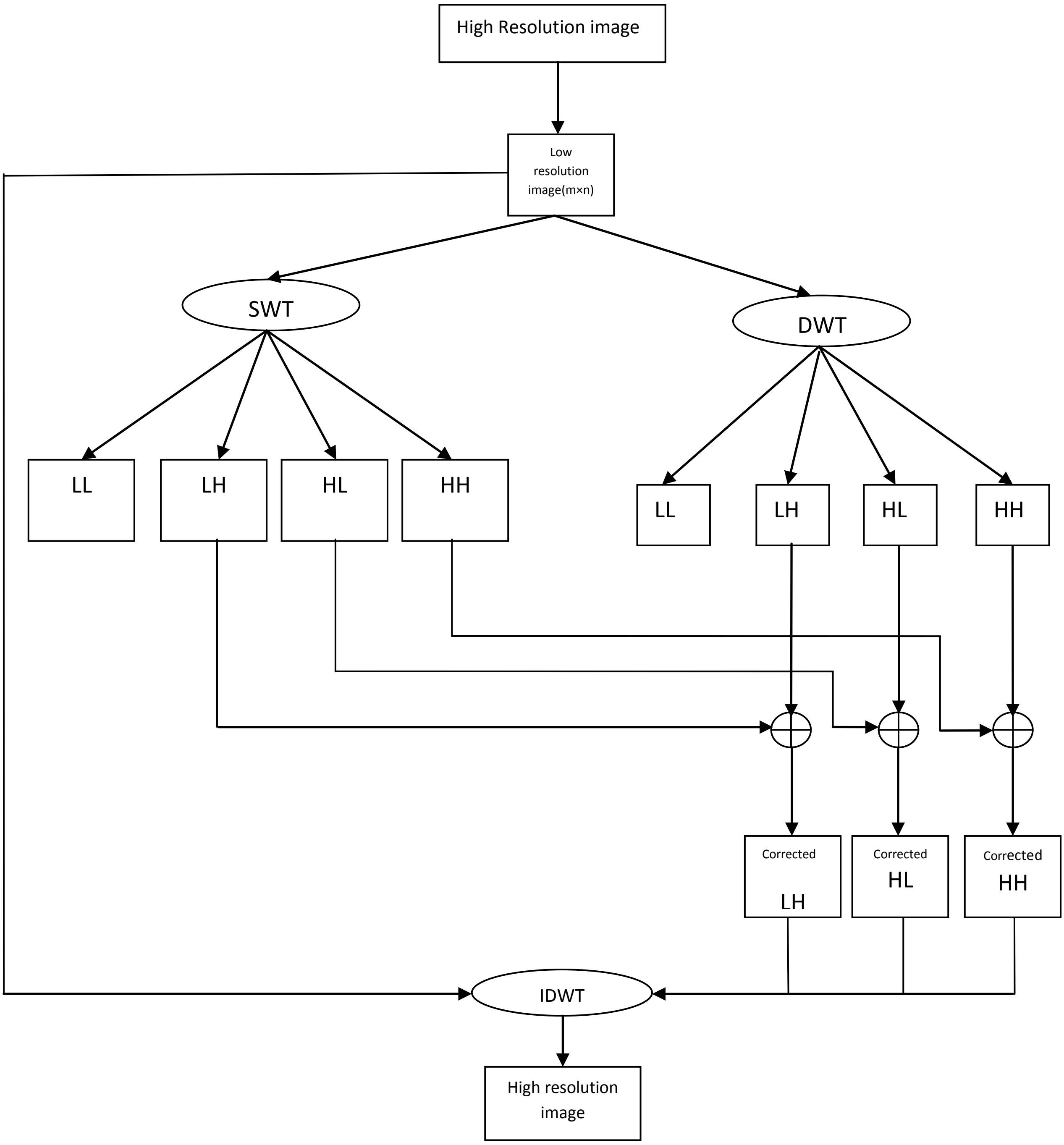


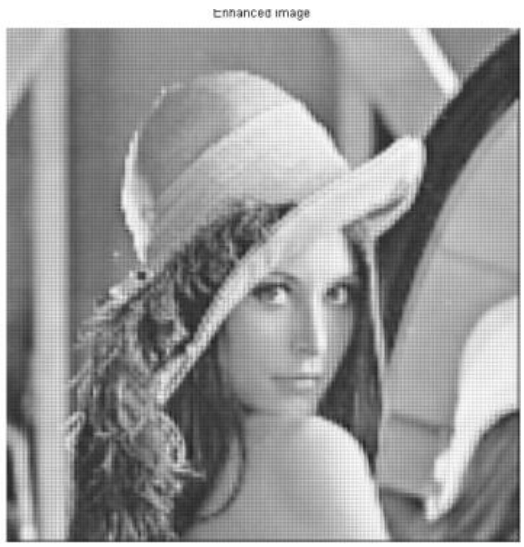
Fig 1- General Block diagram of proposed method

3) This low resolution image is enhanced to 512x512 by proposed method. First take 1 level 2d DWT OF low resolution image

Fig. 2D DWT of down-sampled low resolution image.

First take 1 level 2d SWT OF low resolution image

4) This low resolution image is enhanced to 512x512 by proposed method



5) The original high resolution image is used as ground truth image to calculate Peak signal to noise ratio.

The quantitative (Peak signal to noise ratio) and visual results are superior over the conventional image resolution enhancement techniques.

The performance is calculated by calculating Peak Signal to Noise ratio (PSNR) as given in equation (3).PSNR is performance measure for image quality. Signal to Noise Ratio (PSNR) is generally used to analyze quality of image, sound and video files in dB (decibels). PSNR calculation of two images, one original and an altered image, describes how far two images are equal.

PSNR=10log10 (255×255/ MSE)

MSE - Mean Square error is calculated as

Chart 1:- PSNR values (DB) for images enhanced from 128×128 to 512×512 (α=4)

Method	Lena	Elaine
Bilinear	26.34	25.38
Bi-cubic[2]	26.86	28.93
WZP(db9/7)	28.84	30.44
DWT[11]	34.79	32.73
CWT[3]	33.74	33.05
SWT&DWT(db9/7)[12]	34.82	35.01
Proposed method	35.53	36.65

5. Conclusion

The Table -1 shows that this method is givimg superior results as compared to tradiotional methods. By changing the equation & type of filter used, the results can be further improved by changing the type of filter & its equation. The propoosed method is can be also tested for color images & give the better results.

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