Image Zooming Enhancement using DWT and Fanbeam Projection in Interpolation Technique

K Sugapriya
Dept., of IT
PSG College of Technology,
Coimbatore, Tamilnadu, India

K Kishore Kumar,
Divyapraba
Dept., of ECE, SEEE,
SASTRA University,
Thanjavur, Tamilnadu, India

K Anitha Kumari
Assistant Professor
Dept., of IT,
PSG College of Technology,
Coimbatore, Tamilnadu, India

ABSTRACT
Image zooming had its importance in the real world. Concept of zooming in digital images is based on its intrusion of new pixels into the system. Interpolation is a technique used to obtain newly created pixels from the original image. Fan beam projection calculates different projected images. Generally, it is used to find abnormal opening in the system. In this method DWT is applied initially to original image. Then the computed high frequency bands are interpolated to obtain interpolated sub bands. Fan beam projection of different sub bands levels is fused together to obtain the respective sub band. Applying IDWT to sub bands will result in enhanced zoomed images.

Keywords
Interpolation; DWT (Discrete Wavelet Transform); Fan beam; Fusion; IDWT(Inverse Discrete Wavelet Transform);

1. INTRODUCTION
Image zooming is used in many applications in the field of image processing. It performs the process of obtaining an enlarged image from original with quality to any factor of magnification. In Image zooming some important factors need to consider are image edge, blurring, aliasing. Even Adaptive algorithm has been evolved greatly. But major disadvantage is defect in image pixel will result in image discontinuity. Here, this paper, list out of some few techniques involved in the process of image zooming are Interpolation, DWT, fan beam Projection, Fusion, IDWT.

Interpolation method develops a noteworthy point of preference in the field of both signal processing and image processing. Interpolation can be done in the form of a polynomial. These techniques decide the quality of an image. It meets expectations in both directions to achieve better resolution and pixel color. In order to avoid discontinuities in image interpolation is used. Various methods of image pixel estimation performed on images are Nearest Neighbor- assigning gray value to nearest pixel values, Bilinear interpolation- performs averaging about two pixels, while it provides a significant improvement than nearest neighbor, Bicubic performs surrounding 16 pixels averaging. DWT performs single or multi-level decomposition in images. DWT performs down sampling of images and performs filtering function in images to dissever into various subdivided bands. Fusion technique uses wavelets to conflate two images wavelet decomposition using information from detailed and approximation coefficients. A blending of two images wavelets to obtain new images. Fan beam projection transform calculates sinogram from the image. It is generally used in the system to find minute opening in the structure which preserves the edge content in the image. Various wavelet filters are available such as diabetes, Coiflets, Symlets, Discrete Meyer, and Biorthogonal for the purpose of multi-resolution analysis if the given digital image [5]. Image (A) in section II shows a single level 2-D decomposition performed and Image. (B) shows proposed method for Image Zooming. In section III rresults and ddiscussion of the proposed ttechnique are shown.

2. ZOOMING ENHANCEMENT USING DWT

2.1 Single level 2-D decomposition using DWT
The Resolution Enhancement Technique (RET) is used in image zooming Enhancement. Normally, image interpolation is done by up sampling. Up sampling is done by inserting of zeros followed by filtering the image. The input image is dissevering into low frequency sub bands and high frequency sub bands. High frequency contains detail information about its edges. Information content will be within LL sub bands. High frequency components are interpolated with factor α, while LL band information content will be available from the original image. Inverse Discrete Wavelet Transform is performed to obtain high Resolution Zoomed Image [1] [2]. Main Drawback of these systems is frequency content present in the low resolute image and high resolute image are merely same. Hence the lack of high frequency content resulting in variety of undesirable image with the loss in the form of stair case edges, blocking, blurring [6] [7] [8].

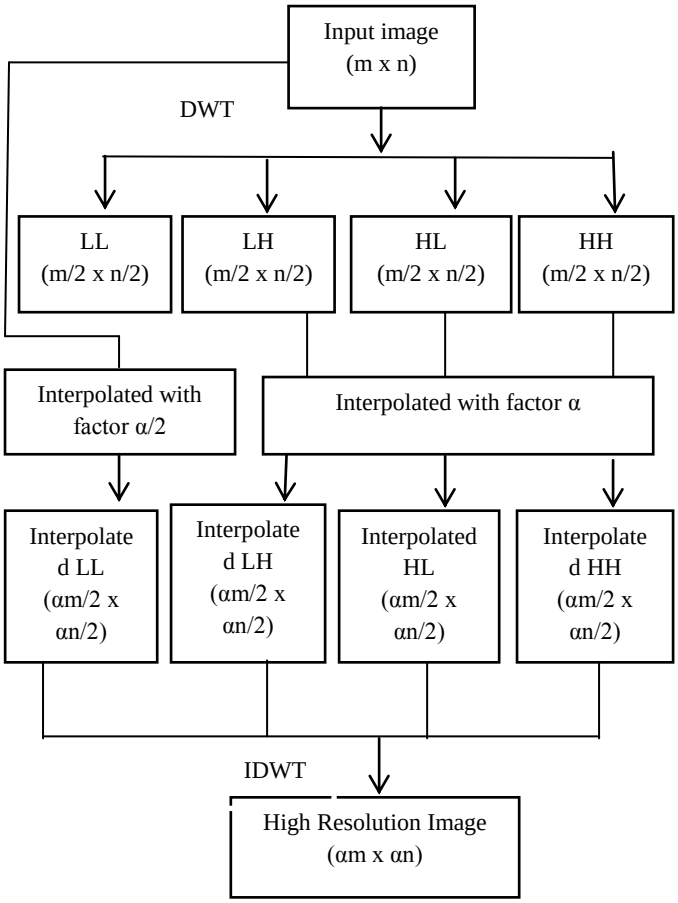


Fig. 1: Block Diagram of Resolution Enhancement using single level DWT

2.2 DWT and Fan beam Projection using Fusion

Interpolation is a strategy to build the quantity of pixels in an image. By applying DWT, image is subdivided into low and high frequency levels. Four bands of decomposition are performed in image to obtain LL, LH, HL, HH bands. Interpolation is performed in order to obtain interpolated high frequency sub bands. Interpolated image projected using fan beam projection [3][4].

Fan beam projection is a transform method to analyze image at different angle from 1 to 360̊. Distance in pixels from the center in the angle of rotation. Different projection of angle produce differently sized image to analyze the value of different sub bands. Fused sub bands act as the input for sub bands for Inverse Discrete Wavelet transform. Biorthogonal wavelet is used for fusion of two images. Biorthogonal uses invertible wavelet transform for fusion of images. Since DWT is efficiency tool for processing image [9] biorthogonal acts as a wavelet in DWT. By obtaining projected image from fan beam transform, it is used as the high frequency components in IDWT. Where low frequency components are obtained from original image by interpolating the image with the factor of α/2.

In this method, the high frequency content of the image preserved by using fan beam projection at different angles are fused together to form an image as high frequency components[9]. High frequency components are preserved in this method. This method of performing a zooming function will not affect image discontinuities.

Let us consider the image of size (m×n). Then the image is transformed using DWT. Various frequency levels are obtained from DWT of size (m/2×n/2).Then the image is again interpolated using bilinear interpolation. Obtained interpolated information is projected. Projection can be done by using a fan beam projection. Projected image of different angle produces the image with variable modification. Projected image at different angles are fused together to form an image. This image act as the sub bands for high frequency component. These high frequency components act as sub bands in IDWT. Low-Low sub band is taken from the original image. LL band is obtained by interpolating the input image with α/2. Obtained low and high frequency components act as sub bands for IDWT. Performed substitution resulted in image zooming [6][7].

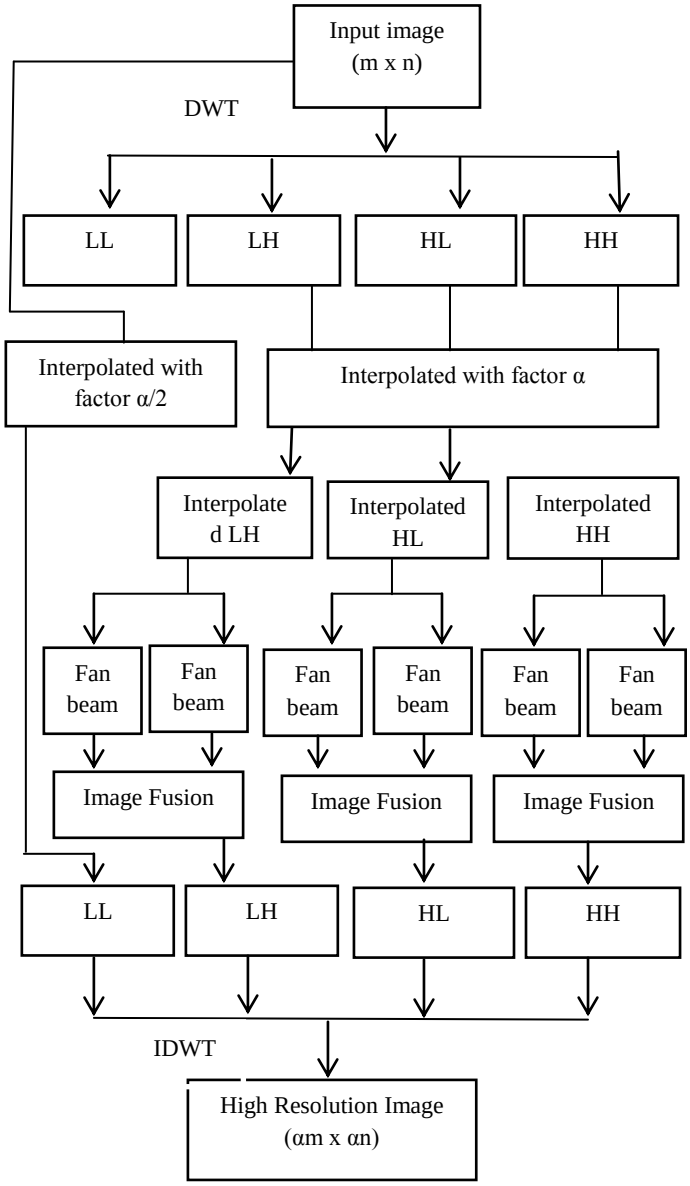


Fig. 2: Block Diagram of Proposed Zooming Enhancement using DWT and fanbeam projection in interpolation Technique

Various methods available in image zooming are bilinear, bicubic, nearest neighbor.

Nearest method will obtain gray value from the integral of nearest pixel, bilinear uses surrounding 4 values. While Bicubic uses nearest 16 pixel values to perform an operation[6][10][11][12]. PSNR and MSE values are shown in table.1, 2.

3. RESULTS AND DISCUSSIONS

3.1 DWT –Interpolation

Let 256×256 cameraman image is taken as the input. Image is dissever into sub bands .These sub bands images are interpolated. Detailed information is available with the high frequency sub bands. Hence sub banded information is interpolated. Followed by, using fan beam projection to transform over these sub bands will obtain the information from image at different angles and fused together to form an image for these sub bands. Then perform IDWT over these sub bands by obtaining low-low band image from the original image.

3.2 Mean Square Error (MSE) and PSNR

The most common measures of image quality are the mean square error (MSE) and the peak signal-to-noise ratio [11] [12]. Let f(x, y) be the original image with size (m×n) and f'(x, y) be the modified image with the same size.

The MSE is expressed as in

$$MSE = \frac{1}{MN}\sum_{xy}(f'(x,y)-f(x,y))^2 \quad (1)$$

and the PSNR in decibel is expressed as in

$$PSNR = 10\log_{10}\left(\frac{255^2}{MSE}\right) \quad (2)$$

3.3 Image Enhancement Factor (IEF)

It is expressed as follows

$$IEF = \frac{\sum_x\sum_y(\eta(x,y)-f(x,y))^2}{\sqrt{\sum_x\sum_y((f'(x,y)-f(x,y))^2}} \quad (3)$$

Where η(x,y) denotes the low resolution image [11] [12]. All mentioned models are implemented using Mat lab Software Tool.

By using high resolution image fig.1.(a) to obtain a low resolution image. Fig.1.(b) is used as Low resolution input image. High resolution image obtained using interpolation is shown in the figure.1.(c)

(a)

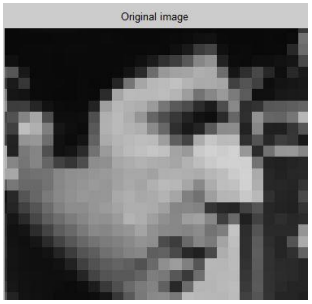
(b)

(c)

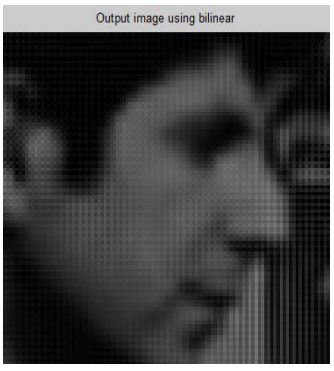
Fig 1: (a) Original image (b) Low resolution Images (c) Interpolated image to original size image

3.4 DWT and Fanbeam projection using Interpolation

(a)



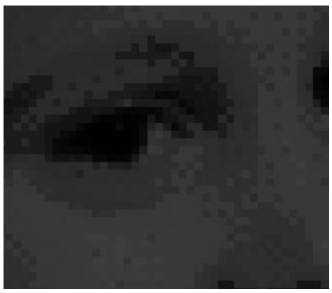
(b)



(c)

Fig 2: (a) Original image (b) using Default zooming in Images . Zooming up to 400%. (c) Zoomed using Proposed method

In Default Zooming visible stair case edges, blocking, blurring are seen in Fig.2. (b). By using the proposed method, interpolated zoomed image obtained is shown in Fig.2. (c)



(a)

(b)

Fig 3: (a) Originally Zoomed image (b) Zoomed resolution Enhanced Image is obtained.

Zooming Enhancement from Original image of high resolute Zoomed image is shown in figure.3.(a),(b)

Table I. Comparison of Various Techniques using Haar Wavelet

Test Images	Nearest neighbor		Bilinear		Bicubic	
	MSE	***PSNR***	***MSE***	***PSNR***	***MSE***	***PSNR***
Cameraman	4493.4	11.61	4494.4	11.64	4458.6	11.67
Cell	3550.2	12.63	3533.9	12.68	3534.0	12.68
Circuit	2000.4	15.12	2000.0	15.15	1988.2	15.18
Pout	3174.9	13.11	3169.9	13.13	3153.1	13.15

TABLE II. Comparison of Various Techniques using Haar Wavelet

Test Images	Lancoz3		Box	
	MSE	***PSNR***	***MSE***	***PSNR***
Cameraman	4447.5	11.69	4420.0	11.71
Cell	3550.2	12.72	3505.2	12.72
Circuit	2000.4	15.19	1971.4	15.22
Pout	3174.9	13.18	3148.2	13.18

TABLE III. Comparison of Various Techniques using BIORTHOGONAL WAVELET – PSNR VALUES

Test Images	Nearest neighbor	Bilinear	Bicubic	Lancoz3	Box
Cameraman	13.42	13.45	13.59	13.68	13.80
Cell	15.43	15.47	15.49	15.50	15.52
Circuit	18.12	18.16	18.18	18.19	18.23
Pout	16.10	16.12	16.15	16.19	16.19

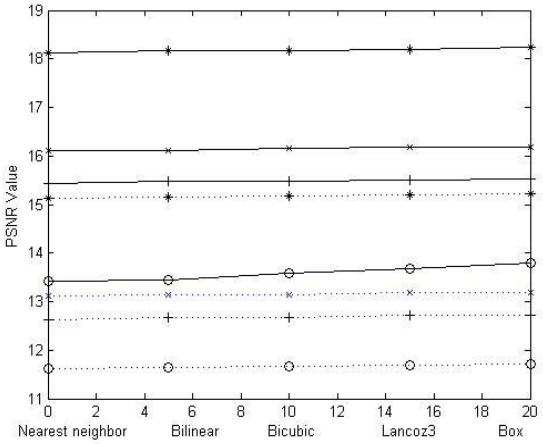


Fig 4:Graph shows the comparison of PSNR values with proposed and other conventional techniques.

Graph shows that the PSNR value is compared with different wavelet. Here dotted line indicates that the techniques use Haar wavelet and solid line indicates that it uses Biorthogonal wavelet. In graph, the symbols 'o, +,*, x' represent 'Cameraman, cell, circuit, pout' images respectively. In graph, it is clearly shown that enhanced image is 2 dB more than that of original image is indicated in figure 4.

4 CONCLUSIONS

By using DWT and Fan beam projection technique, the visual quality of the interpolated image and the information content is better than other techniques. PSNR values compared with other conventional techniques. Resultant Image is used in various applications like medical diagnostic imaging, biological imaging, human machine interface, cinematography, remote sensing, document processing, automation and robotics, etc.

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