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Image Sharpening using Unsharp Masking and Wavelet Transform

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Abstract: The fundamental idea of image sharpening is to improve image contrast and brightness. Input signals are passed through high-pass filters. Wavelet coefficients provide high frequency coefficients of an image. For this purpose, a wavelet-based algorithm was proposed that combines DWT (HAAR) and Unsharp Masking technique. Edge information of an image is obtained from wavelet coefficients. To generate the sharpen image, image components was processed with Unsharp Masking (UM). In this proposed algorithm experimental results enhance image quality. The amount of image sharpening was calculated with the percentage rise in the value parameter. Experimental observation show there was an enormous sharpening in image reproduction by using this proposed algorithm (DWT-UM). It was observed that there was a 7.47 % rise in the value parameter in original image whereas after processing with proposed algorithm, it was observed 30.59% rises in the value parameter. This proves that proposed approach is very efficient approach for sharpening an image.

Keywords: Image Processing; Digital Image; Image Sharpening; Unsharp Masking; Discrete Wavelet Transform (HAAR).

I. INTRODUCTION

Image sharpening is the process of manipulating images so that images become more suitable than the original image. Sharpening improves the visual appearance of images, though sharpening of image features such as edge or contrast. A large number of algorithms have been designed for this purpose such as Unsharp Masking, DWT (HAAR) and Laplacian filtering etc. where An image may be define as 2-D function of $f(x, y)$, where x and y are the spatial coordinates and amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. A digital image is composed of a large number of elements referred as picture elements, image elements, pels and pixels [1]. Yeong-Hwa Kim *et.al* [2] proposed an image feature and noise adaptive Unsharp Masking (UM) algorithm that enhances local contrast of an image and also image detail without amplifying noise by statistically discriminating them which requires no information of the noise. Andrea Polesel *et al*. [3] proposed Image enhancement via adaptive Unsharp Masking. This algorithm employs two directional filters and coefficients of these are updated using a Gauss–Newton adaptation strategy. Liu Ying *et al*. [4] Proposed wavelet based image sharpening algorithm based on UM. The author correlates different wavelet coefficients to remove noise and set high frequency coefficients as the edge of the original image.

In this paper, we proposed an algorithm that combines 2D-DWT (HAAR) and Unsharp Masking technique. This algorithm proves efficient algorithm than previous algorithms. In this paper, we examined the sharpness at pixel level.

The remainder of this paper is organized as follows. In Section II, we present general DWT, in section III. UM techniques, Section IV briefly, presented the sharpening detection algorithm, followed by the simulation results for proposed algorithm in Section V. Section VI described the conclusions

II. Discrete Wavelet Transform (DWT)

In DWT signal is decomposed line by line and column by column. In level 1 , 2D-DWT wavelet filter is convolved with both rows and column of the image results 4 subbands LL_1 , LH_1 ,HL_1 ,HH_1. For the next level same procedure is applied to LL_1 subband that turns into four sub-subbands LL_2 , LH_2 ,HL_2 ,HH_2 . To process J level this procedure iterates J times and we get 3* J +1 subbands. Figure 1 shows level 1 decomposition.

0	1
2	3

Fig 1: Level 1 2D-DWT

III. Unsharp Masking (UM)

Unsharp masking is a technique to highlight edges of the image. It is a three-step process firstly blurred copy of original image is created called mask image, Then the mask image is subtracted from original image finally result is added in original image. Blurring process reduces the high frequency content and does not change the density of the large area in which small details are contained. The unsharp mask technique (UMT) mathematically described as follows:

$$I_p(\mathbf{x}\ ,\ \mathbf{y}) = \mathbf{I_o}(\mathbf{x}, y\ ) + A.[\ I\ o\ (\ x\ ,\ y\ ) - I_m(x, y)] \quad (1)$$

Where $I_o(x, y)$ and $I_p(x, y)$ are the values of the picture (x, y) on the original and processed image, also $I_m(x, y)$ is the blurred version of original image [6].

IV. Proposed Algorithm

This study proposed an algorithm that combines 2D-DWT (HAAR) and Unsharp Masking. Unsharp Masking was applied to obtain edge information. UM on the transform was used to obtain the high-frequency spatial detail coefficients. In this approach 2D-DWT was applied to obtain approximation coefficients and detail coefficients. Approximation coefficient represented as CA coefficient where as in detail coefficients we got horizontal (CH), vertical (CV) and diagonal (CD) coefficients. Then each of the coefficients was processed with UM. We obtain new coefficients (CA’,CH’,CV’,CD’). Complete procedure is shown in figure 2.

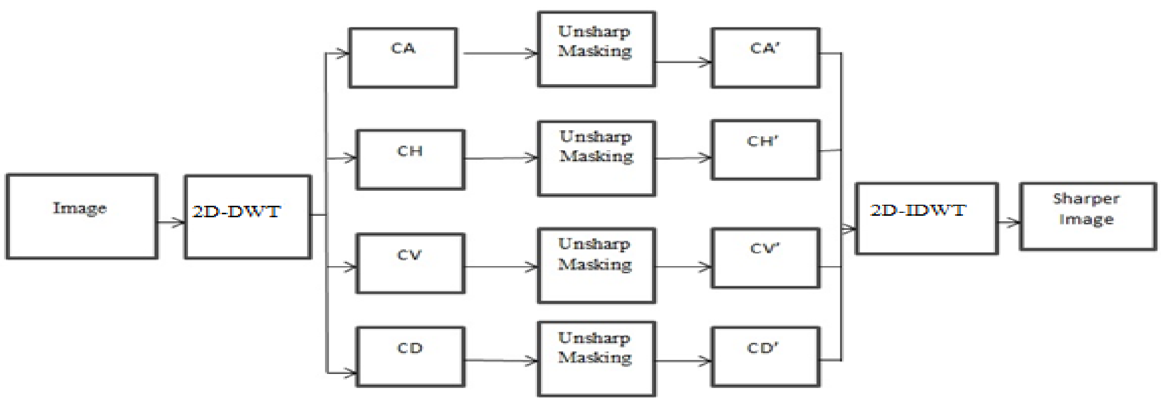

Fig.2 Proposed algorithm 2D-DWT and UM to compute the Sharpeners of Image

V. SIMULATION RESULTS

This section contains simulation results to validate performance of proposed algorithm. Here fig. 3 shows original image. Proposed algorithm was implemented on original results shown in fig. 4. This show sharpen image after processing with our proposed algorithm. Further amount of sharpness was calculated by percentage rise in pixel parameter.

Fig. 3 Original Image

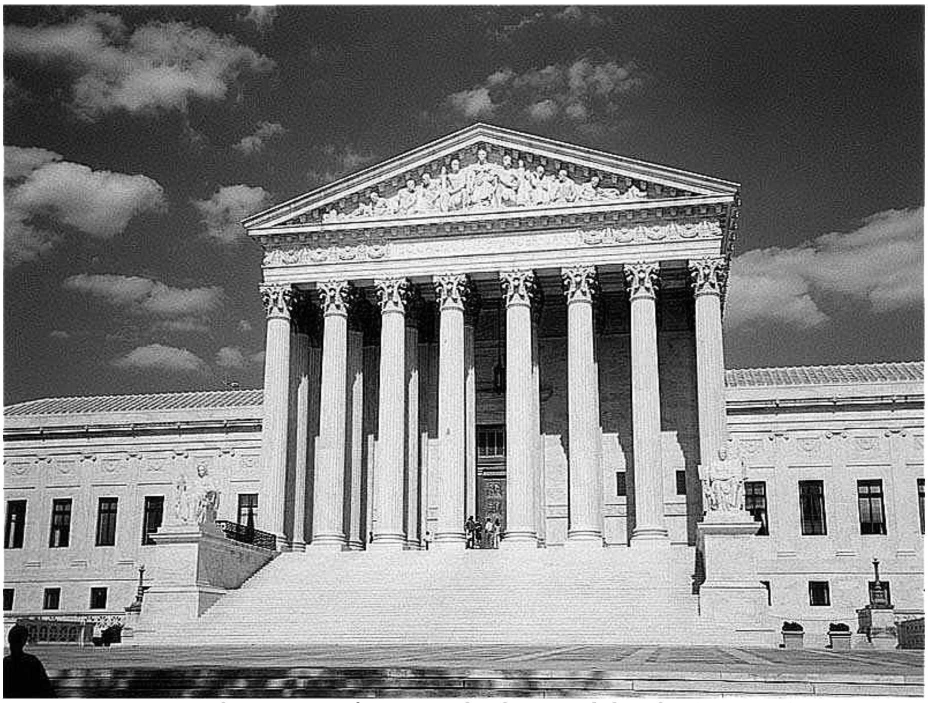

Figure 5: Sharpen image after processed with proposed algorithm (DWT-UM)

A. Analysis at Pixel Level

Pixel values were observed before and after processing with proposed algorithm (DWT-UM). To analyze edge sharpness small part of image was selected represented in rectangle. The pixel values inside selected rectangle were represented in table 1.1-1.2. Change in pixel value is distinguished by different colors red and black color.

B. Rise in Value Parameter

The rise in value parameter was used to measure sharpness in an image. High frequency pixel values are edges. More the rise in pixel parameter more was the sharpness. In this study average value of red value just along the boundary and average of black values was taken.

In fig .6 and 7 Small part was selected from original image and image processed with proposed algorithm was selected, and to calculate percentage rise in pixel value. Table 1.1-1.2 shows pixel values of selected rectangular part.

Fig 6: Cropped Original image

TABLE 1.1: Values of pixels in a small part of original image

88	87	88	89	86	87	87	95	93	92	92	85
87	86	89	93	91	86	84	87	86	86	84	82
89	85	86	90	91	88	86	87	92	88	86	90
92	85	80	83	87	88	90	92	85	81	83	89
91	85	82	86	89	88	87	88	89	90	93	94
87	85	87	92	93	86	81	80	93	98	98	93
85	84	86	89	88	84	85	88	79	84	81	74
87	82	79	78	78	82	94	107	83	88	83	76
128	149	127	102	110	114	135	189	149	147	127	128
185	193	192	183	180	180	175	172	184	195	204	208
137	133	166	197	184	162	149	134	175	181	174	167
145	157	167	150	116	112	145	176	180	153	115	116

Average value of red values in 6th column (Avg_{red}) = 108.166

Average value of blue values in 7th column (Avg_{black}) = 116.25

Percentage of rise in values (P_{rise}) $= \frac{(Av_{black} - Av_{red}) \times 100}{Av_{red}}$

$$= \frac{(116.25 - 108.166) \times 100}{108.166}$$

= 7.47% There was 7.47 % rise in value pixel parameter.

Fig 7: Cropped Sharpen image after processed with DWT-UM

Table1.2: Values of pixels in a small part of image processed with DWT-UM

0.286275	0.360784	0.333072	0.33268	0.277778	0.256993	0.249281	0.300654	0.30366	0.294118	0.324183	0.332026
0.308497	0.32549	0.34902	0.321569	0.23268	0.458824	0.112418	0.362092	0.315033	0.30719	0.337255	0.364706
0.286275	0.273203	0.291503	0.315033	0.322876	0.4	0.296732	0.352941	0.300654	0.296732	0.301961	0.326797
0.300654	0.294118	0.324183	0.364706	0.420915	0.27451	0.473203	0.296732	0.295425	0.282353	0.281046	0.286275
0.389542	0.369935	0.317647	0.279739	0.243137	0.236601	0.248366	0.32549	0.385621	0.384314	0.339869	0.320261
0.213072	0.290196	0.405229	0.439216	0.260131	0.15817	0.34902	0.173856	0.113725	0.379085	0.443137	0.211765
0.500654	0.118954	-0.22484	-0.18824	-0.18431	0.666667	-0.03268	0.501961	-0.07451	-0.3634	-0.36471	0.054902
1.166013	0.955556	0.792157	0.976471	1.087582	1.31634	1.339869	1.12549	1.026144	1.47451	1.563399	1.133333
0.402614	0.704575	1.120261	1.065359	0.439216	0.145098	0.219608	0.551634	0.777778	0.955556	0.581699	0.087582
0.541176	0.788235	0.780392	0.583007	0.329412	0.511111	0.515033	0.847059	0.673203	0.354248	0.239216	0.473203
1.135948	0.573856	0.010458	0.04183	0.257516	1.386928	0.704575	0.76732	0.071895	0.298039	0.743791	0.837908
0.346405	0.111111	0.478431	1.069281	0.934641	-0.09281	0.652288	0.014379	0.436601	1.247059	1.192157	0.385621
0.647059	0.735948	0.80915	0.74902	0.277124	0.691503	0.077124	1.177778	0.998693	0.396078	-0.13725	0.014379

Average value of red values in 6th column (Avg_{red}) = 0.400372

Average value of blue values in 7th column (Avg_{black}) = 0.522876

Percentage of rise in values (P_{rise}) = $\frac{(Av_{black} - Av_{red}) \times 100}{Av_{red}}$

$$= \frac{(0.522876-0.400372) \times 100}{0.400372}$$

$$= 30.59\%$$

Here we got 30.59 % rise in value parameter.

It was observed that there was 7.47 % to 30.59 % rise in value near edge of original image and image after processing with our proposed algorithm. Our experimental results shows there was enormous increase in percentage rise in value parameter after processing with our proposed algorithm (DWT-UM).

VI. Conclusion

This study presented wavelet and Unsharp Masking based image sharpening algorithm. This algorithm makes use of correlation between different wavelet coefficients; we describe high frequency coefficients as edge of the image. Edge information of an image is obtained from wavelet coefficients. To generate the sharpen image, image components was processed with Unsharp Masking (UM). Experimental results show effectiveness of proposed algorithm. It was observed that there was a 7.47 % rise in the value parameter in original image whereas after processing with proposed algorithm, it was observed 30.59% rises in the value parameter. This proves that proposed approach is very efficient approach for sharpening an image**.**

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References

1. Gonzalez Digital Image Processing Prentice Hall 2nd Edition 2002.
2. Yeong-Hwa Kim and Yong Jun Cho , "Feature and Noise Adaptive Unsharp Masking Based on Statistical Hypotheses Test" IEEE Transactions on Consumer Electronics, vol. 54, no. 2,pp.823-830, 2008.
3. Andrea Polesel, Giovanni Ramponi, and V. John Mathews, "Image Enhancement via Adaptive Unsharp Masking" IEEE Transactions on Image Processing, vol. 9, no. 3, pp.505-510,2000.
4. Liu Ying, Ng Tek Ming, Liew Beng Keat , "A Wavelet Based Image Sharpening Algorithm" International Conference on Computer Science and Software Engineering , pp 1053-1056,2008.
5. Hasan Demirel, Cagri Ozcinar, and Gholamreza Anbarjafari ,"Satellite Image Contrast Enhancement Using Discrete Wavelet Transform and Singular Value Decomposition," IEEE Geoscience and Remote Sensing Letters, vol. 7, no. 2, pp.333-337, 2010.
6. Jadwiga Rogowska, Kendall Preston, Jr.,and Donald Sashin," Evaluation of Digital Unsharp Masking and Local Contrast Stretching as Applied to Chest Radiographs", IEEE Transactions on Biomedical Engineering, VOL. 35, NO. 10,pp817-827,1988.
7. Rangaraj M. Rangayyaannd Arupd As, "Image Enhancement Based on Edge Profile Acutance", J.Indian Inst.Sct,pp17-29,1998.
8. Nitin Saluja, Anoop Kumar, Amisha, Dr. Rajesh Khanna, " Cropping Image in Rectangular, Circular, Square and Triangular form using Matlab", National Conference on Computational Instrumentation ,pp.86-88, March 2010.
9. Xiu-bi Wang, "Image edge detection based on lifting wavelet," IEEE International Conference on Intelligent Human-Machine Systems and Cybernetics pp.25-27, 2009.
10. Jiang Lixia, "Study on Improved Algorithm for Image Edge Detection," IEEE pp.476-479,2010.

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