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Back Propagation Network using Fractioned Cover Image and Fractioned Watermarks

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Abstract: A new watermarking scheme can be devised where small fractions of cover image can be trained using BPN to generate small fractions of target watermark. The fractioned watermarks can be reunited to build the full watermark image again. The idea of using small fractions instead of full watermark has lead to improvement in the desirable characteristics of watermarking with enhanced robustness and fidelity aspect.

Index terms: watermarking, BPN, Fractioned watermark, Fractioned cover image

I. INTRODUCTION

A Backpropagation Network may be successfully trained to generate watermark fractions using fractioned cover image parts as inputs. These watermark parts can be united to obtain the original gray scale watermark again. This scheme will
Helpful in providing high fidelity as it is evident by the results obtained.

II. APPROACH: WATER MARKING APPROACH

A. The cover image is converted into DCT domain and a 4 □ 8 binary matrix for ownership identification is inserted into the mid band coefficients. Inverse DCT is taken to obtain the cover image in the spatial domain.
B. The target watermark image is taken and divided into small fragments with two rows and four columns.
C. A Backpropagation Neural Network is chosen with 1 input, 1 hidden and 1 output layer.
D. The fractions of cover image are supplied as input to the input layer of the BPN respectively and weights of the network are adjusted to produce the fractioned target watermark.
E. Now the fractioned output watermarks are united to produce full watermark image.

III. WATERMARK EXTRATION

A. The watermarked image after being subjected to various image attacks is supplied to the image corrector and the corrected watermarked image received from the image corrector is converted into DCT domain and the ownership identification matrix is recovered and verified..
B. The watermarked image is taken and divided into small fragments as in the embedding stage.
C. Each watermarked image fragment is used to derive corresponding watermark fragment using trained BPN.
D. Watermark fractions are assembled to build the complete watermark.

IV. EXPERIMENNT CONDUCTED AND THE RESULTS

All experiments were conducted on genuine intel (R) CPU T-2050 @1.60GHZ, 504 MB of RAM. The Operating system used was Microsoft Windows XP Home edition, Version 2002, Service Pack 2. For conducting the experiments, BPN network with one INPUT layer, one Hidden layer and one output layer was used to train the cover image fractions into target watermark fractions.

A. Generation of Watermark

Now, all the fragments of cover image are generated from the fragments of the watermarked image and are supplied as inputs to the trained Backpropagation Network respectively and the corresponding fragments of output watermark are obtained which are united to create the complete watermark. This is done for different values of error threshold.

B. Variation of PSNR with Threshold

In the first experiment, the variation of PSNR values with respect to change in threshold value is seen. The threshold is varied from 0.4 to 0.0001 as shown in table 1.1. With the reduction in the threshold value, the PSNR goes on increasing. There is also an increment seen in training time and number of epochs required for training. The values of learning rate (□)is kept at 4 and the value of momentum factor (*mf)* is also kept constant at 0.8. The PSNR varies from 16.35 to 40.72. The best PSNR value is obtained at threshold value of 0.0001 with a training time of 321.89 seconds and number of epochs as 223469. Figure 1.11 to Figure 1.14 show the extracted watermark image corresponding to threshold values of 0.1,0.01,0.001 and 0.0001 respectively. The Figure 1.10 shows the variation of PSNR values with respect to various threshold values.

TABLE 1.1. Variation of PSNR with threshold (BPN with random matrices □ =4,mf=0.8)

α	mf	Threshold	PSNR (dB)	Trai ning time (sec.)	Epochs
4	0.8	0.4	16.35	18.98	6466
4	0.8	0.3	17.36	21.48	8428
4	0.8	0.2	18.92	25.76	11462
4	0.8	0.1	21.85	34.10	16947
4	0.8	0.01	30.74	64.51	38875
4	0.8	0.001	37.73	126. 43	83498
4	0.8	0.0001	40.72	321. 89	223469

(□ =4 , *mf*= 0.8)

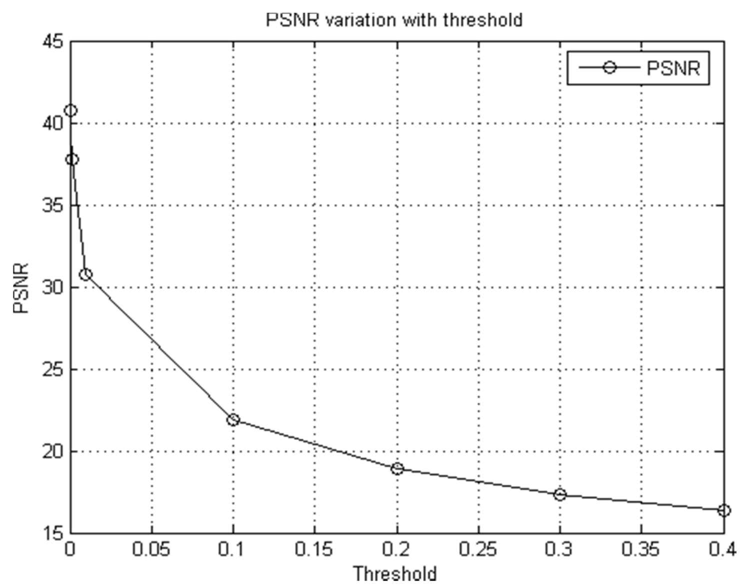

Figure 1.10 Variation of PSNR with threshold

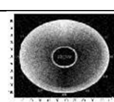	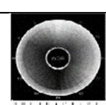	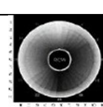	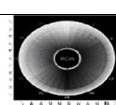
Figure 1.21 Extracted watermark at Threshold= 0.1	Figure 1.22 Extracte d waterma rk at Threshol d = 0.01	Figure 1.23 Extracted watermark at Threshold = 0.001	Figure 1.24 Extracted watermar k at Threshold = 0.0001

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V. EXPERIMENTAL RESULTS (ROBUSTNESS, FIDELITY AND PAYLOAD)

The value of PSNR varied from 21.85 to 40.72 for a variation in threshold from 0.1 to 0.0001. The best value of PSNR of watermark was recorded as 40.72. So, the training is done with a threshold value of 0.0001. When a single bit was used for ownership identification the PSNR of the 'watermarked image' was reported as 148.4780 which is also shown in the paper [A-9](Appendix- A). However, when a DCT encoded ownership identification bits matrix of a greater size , as shown in this chapter was inserted, the fidelity of the watermarked image came down to 48.63 [A- 12] Appendix-A which is a practically realizable value of fidelity. The following results are with fidelity = 48.63 dB and threshold = 0.0001. The Watermarked image is subjected to various attacks and the results are shown in table 1.2.

Table 1.2(Results observed for selected Fidelity = 48.63 dB, Threshold= 0.0001)(BPN with random matrices)

Cover Image	Watermark Image	PSNR(dB) of watermarked image(Fidelity) (With DCT encoded ownership identification bits) and NC of watermark extracted (no attack situation)	Size of watermark inserted	Attack	PSNR (dB) of extracted watermark & NC of extracted watermark (post correction of watermarked image after attack)
		48.63,0.998	(117×114) pixels with 256 gray values	Blurred (0.5 %) 3 □ 3 averaging filter	40.72,0.954 40.70,0.954
				Cropped (30%)	40.70,0.954
				Sharpened (30%) 3 □ 3 laplacian filter	40.71,0.954 40.72,.954
				Compressed (CR=10.75) & (QF = 50%)	40.69,0.954
				Gaussian noise 25% Variance=0.1	40.69,0.954 40.87,0.957
				Contrast enhanced (40%) 3 □ 3 contrast enhancement filter	40.60,0.952 40.62,0.953
				Rotated (15^0)	40.63,0.954
				Scaled (50%)(1-1/2-1) 1-3-1	40.66,0.954 40.66,0.952

VI. CONCLUSION

The results obtained for fidelity and robustness after performing the attacks and restoring the watermark are promising. This shows that the method involving watermark fractions along with cover image fractions.in conjunction with BPN may be practically employed as an effective watermarking technique for digital watermarking applications on gray scale images.

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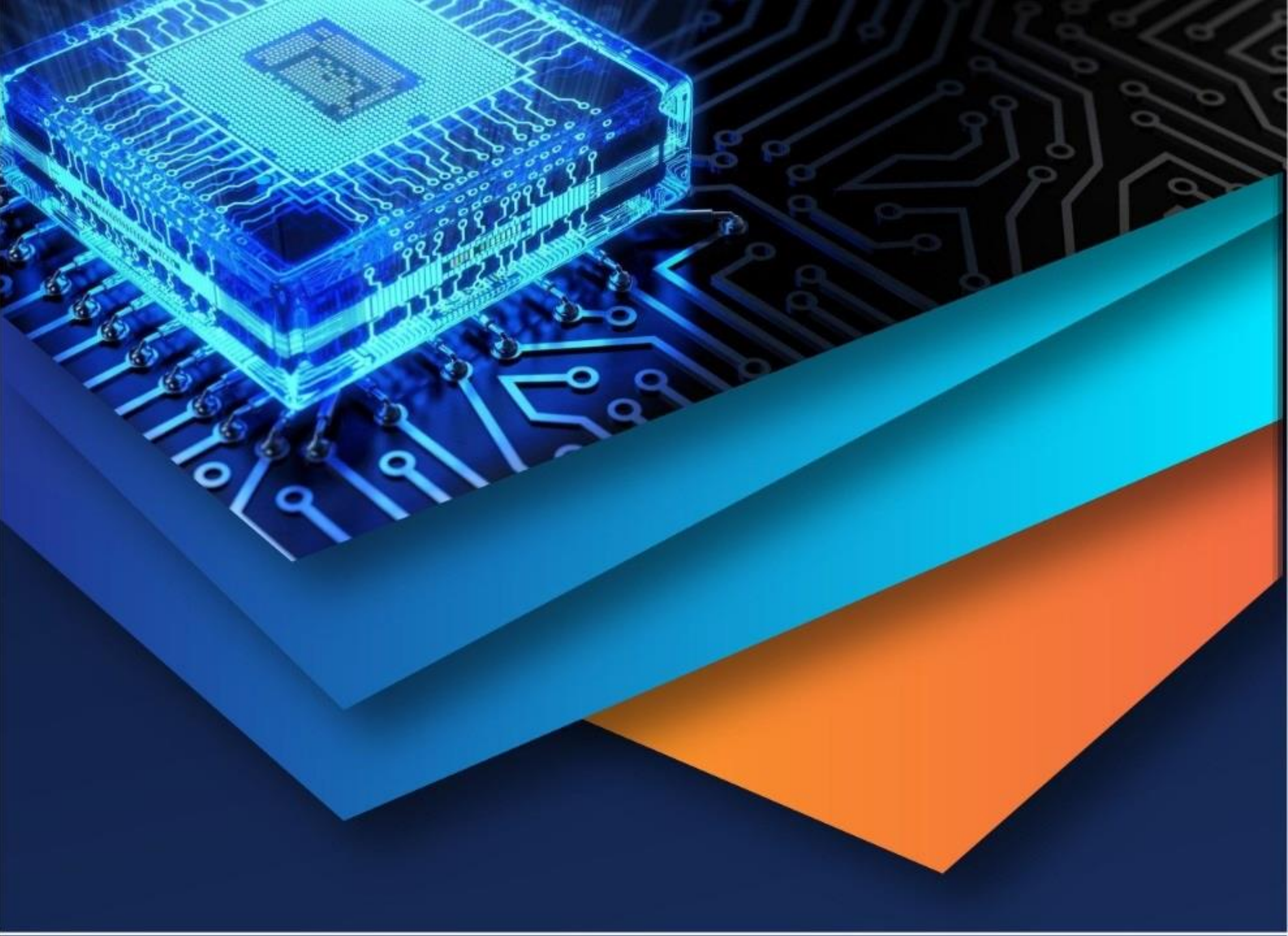

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