IJCAT - International Journal of Computing and Technology, Volume 1, Issue 10, November 2014
ISSN : 2348 - 6090
www.IJCAT.org

Multiscale Gradient Direction Quantization Based Watermarking

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Abstract - Gradient direction watermarking is uniform quantization of the direction of gradient vector. In this watermarking method watermark embedded in angle of significant gradient vector. This watermarking has following advantages.1) Invisibility of watermark as watermark is embedded in gradient vector 2) Robust against amplitude scaling attack.3) watermarking capacity increased due to multiscale embedding.

Keywords **– Multiscale, Quantization, Watermarking.**

1. Introduction

Watermarking classified into two categories spread spectrum(ss) watermarking and quantization based watermarking .In ss type watermarking, adding a pseudorandom noise like watermark into host signal ,and is robust to many types of attacks. In quantization based watermarking ,each watermark bit is represented by quantized feature value, a set of features extracted from the host signal are quantized .But quantization based watermarking methods easily break to amplitude scaling attacks .such attacks does not degrade the quality but increase bit-error-rate(BER).To deal with this issues angle QIM (AQIM) has been proposed ,where only the angle of a vector of image features are quantized .Embedding the watermark in the vectors angle makes the watermark robust to changes in the vector magnitude, such as amplitude scaling attacks.

2. Watermark Embedding Method

Fig shows the block diagram of the proposed embedding scheme. First DWT is applied to the image. Traditional gradient estimators, such as Sobel estimator ,have the problem of inter scale dependency , that's why we used DWT. Then we calculate the gradient vectors in terms of vertical, horizontal and diagonal wavelet coefficients. To embed the watermark bits we partition the gradient vectors into non overlapping blocks. Each watermark bit is inserted into the most significant gradient vectors of the block.

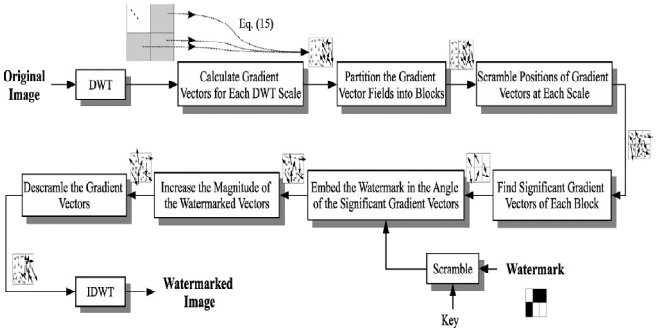

Fig 1 Embedding Watermark

In natural image some parts may have all or most of the significant vectors , while other parts may have none, this causes two problems: 1)Less robust to attack.2)Easily extract watermark bit .To address problem 1 we scramble position of gradient vectors at each scale so each block contain at least one significant gradient vector .Uniform vector scrambling increasing the gradient magnitude entropy, thus reduces the probability of finding two vectors with similar magnitude in each block. For problem 2,we increasing the differences in the magnitude of watermark and un watermark vectors is also proposed to help identify the watermarked vectors correctly.

3. Decoding Method

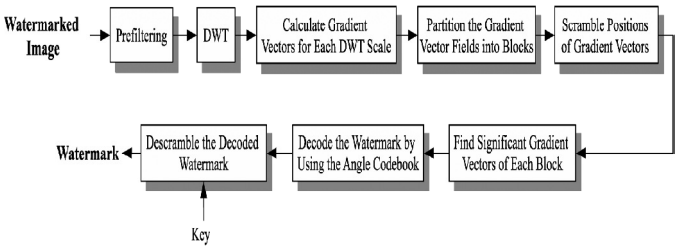

Fig 2 Decoding method

The watermark bits are decoded following the reverse encoding step , as shown in fig2. At the transmitter side, each watermark bit is embedded into the most significant gradient vectors of each block. At the receiver side, we decode the watermark bit of the most significant vectors and assign weights to the decoded watermark bits based on the following rules:

1) A watermark bit extracted from a large gradient vector should be given more weight than a bit extracted from a small gradient vector.
2) 2) A watermark bit extracted from an angle close to a sector centroid , should be given more weight than a bit extracted from an angle close to a sector boundary.

4. Simulation and Results

To evaluate the performance of the proposed method, we embed different pseudorandom binary watermarks of size 256 in the gray-scale test images . To measure the similarity of the original image to the watermarked image, the peak signal-to-noise-ratio (PSNR) is employed. The original and watermarked images shown in Fig .bellow illustrate that the watermark embedded with the proposed gradient direction watermarking (GDWM) method is imperceptible. Fig 3 shows performance graph of original, watermarked and cropped image.

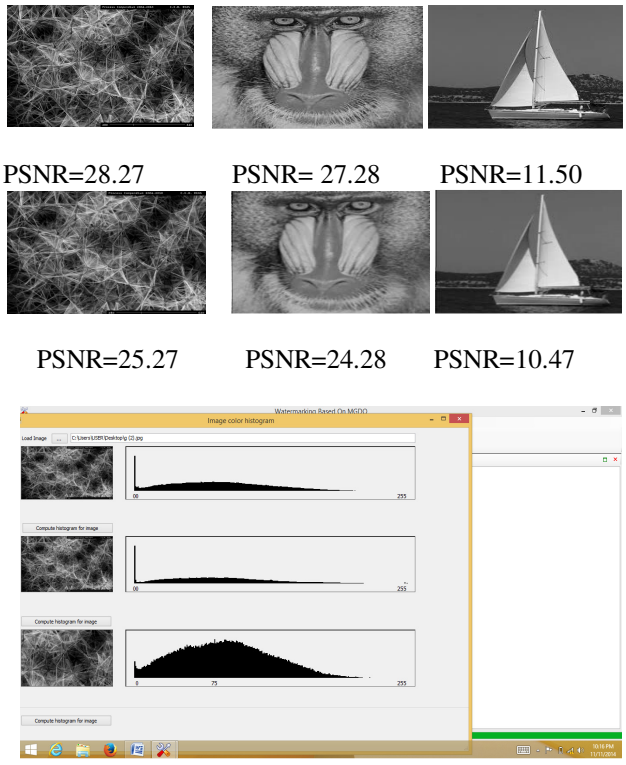

Fig 3 performance graph of watermarked ,original and cropped image

5. Conclusion

To embed the watermark in gradient direction ,we find it in terms of wavelet coefficients and then quantized by modifying the DWT coefficients. With the study of various relevant papers it is observed that to extract the watermark correctly, the decoder should be able to identify the gradient vectors that were watermarked. To solve these problems, we propose scrambling the positions of the gradient vectors uniformly over the wavelet transform of the image .The results shows that the proposed method is superior robustness to different types of attacks.

Acknowledgement

I am profoundly grateful to Prof. Aditi Jahagirdar for her expert guidance. I would like to thanks head of department Dr. Kishor Kinage for his support. I would like to express my deepest appreciation towards Dr. Wadhai Principal, M.I.T.C.O.E. Pune. I would like to thanks all staff members for their kind support.

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