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Speech Modulation for Image Watermarking

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Abstract – : In this paper, a new technique of image water marking approach using data modulation was proposed. This technique consists of converting an RGB image in to grey image of two dimensional matrix. Then DCT is applied to that matrix and watermarking signal is inserted in to those DCT values. This watermark signal is obtained after applying HAAR wavelet transform to original reshape signal. After inserting the watermark signal, the inverse of DCT is applied in order to produce the watermarked asset. The extraction process is performed by subtracting the original DCT coefficients from the watermarked image after extracting the original signal, is done by using HAAR wavelet transform.

Index terms – DCT; image watermarking; data modulation embedding; speech signal; HAAR wavelet

Introduction

Embedding a hidden bit stream in a file named as Digital Watermarking. This file could be of any form like a text, an image, an audio or a video. In literature, the host file is called "asset" and the bit stream is called the "message". Digital watermarking is an emerging technology and has many applications like broadcast monitoring, owner identification proof of ownership, content authentication, transaction tracking, device control, file reconstruction and copy control[1]. The major specification of a watermarking system are:

- Robustness
- Imperceptibility
- Capacity

The importance of each depends on application. As a matter of fact there exist a trade off between these two factors[2]. Even though watermarking in some literature includes visible imprints, in this paper we only mean the invisible embedding of data.

The spatial domain watermarking techniques are simpler and are less robust against different geometric and non geometric attacks[4]. The representative transform domain algorithms embed the watermark by modulating the magnitude of coefficients in a transform domain, such as DWT[5] and SVD[6,7,8,9]. Transform domain techniques can allow more robustness against many common attacks and more information embedding. Nevertheless the computational cost is higher than spatial-domain watermarking techniques.

DWT is very appropriate for identifying areas in the cover image where as the watermark can be imperceptibility embedded due to its good properties of spatio-frequency localization. An important mathematical property of SVD is that slight variations of singular values don't have any influence on the visual perception of the host image, which motivates the watermark embedding procedure to achieve robustness and good transparency[10].

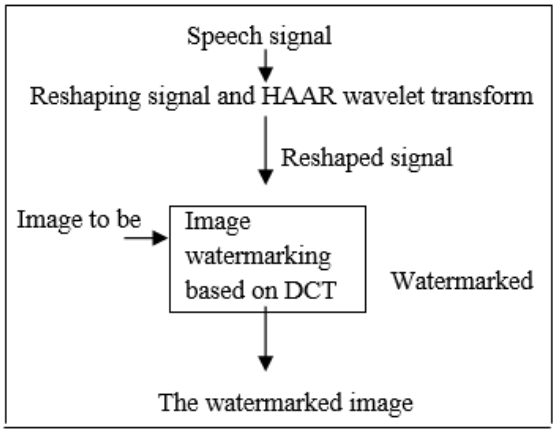
In the next section, we will present with details the new proposed image watermarking approach. The third section is devoted to good results and evaluation.

The proposed technique of image watermarking

In this work, we propose a new image watermarking approach using data modulation. This approach consists firstly in getting the first color in case of RGB image which is a 2D matrix. Then the Discrete Cosine Transform (DCT) is applied to this matrix and the watermark signal is inserted into the obtained after reshaping of the original speech signal. After embedding the watermark signal, the inverse of

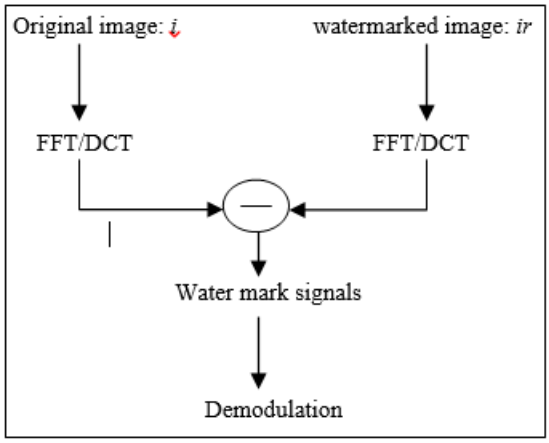
DCT is applied in order to obtain the watermarked image ones. The extraction process is simply subtracting the original DCT coefficients from the watermarked image ones. After the extraction of the modulated signal, the latter is demodulated in order to recover the original signal. In fig.1, is illustrated the follow chart of this technique:

fig:1.The flow chart of the proposed technique of image watermarking



The processing of the matrix from the application of the DCT to the image to be watermarked, is detailed in[3].

fig:2. The flow chart of the watermark signal extraction



In Fig: 2, is illustrated the system of watermark signal extraction. According to this figure, the first step of this system consists in applying the DCT to both original and watermarked images. In order to obtain the watermark signal the second step consists in subtracting the DCT coefficients obtained from watermarked image ir from those obtained by applying the DCT to the original image i. The extracted watermark signal is then demodulated.

Criteria of evaluation

Different functions are used to test the performance of the watermarking through the examining tests on the resulted watermarked image.

Robustness

The robustness of a watermark technique can be evaluated by performing attacks on the watermarked image and evaluating the similarity of the extracted message to the original one.

Imperceptibility

The imperceptibility of the watermark is tested through the comparison between the watermarked image and the original image. Different tests are usually employed in this regard.

Mean squared Error:

The Mean Squared Error (MSE) is one of the earliest tests that were performed to test if two images are similar. It is expressed as follow:

$$MSE=\frac{1}{n}\sum_{i=1}^{n}(X_i - X_i *)\text{^}2$$

Pick Signal to Noise Ratio (PSNR)

Pick Signal to Noise Ratio (PSNR) is a better test since it takes the signal strength into consideration (not only the error). It is expressed as follow:

$$PSNR=10.\log\left(\frac{MAX_i2}{MSE}\right)$$

SSIM:

The main problem about the previous two criteria is that they are not similar to what similarity means to human visual system (HVS). Structural Similarity (SSIM) is a function expressed in equation (8) and introduced by Wang et al. for overcoming this problem to a great extent.

$$SSIM = \frac{(2\mu_x\mu_u+C_1)(2\sigma_{xu}+C_2)}{(\mu_x2+\mu_u2+C^2)(\sigma_x2+\sigma_u2+C_2)}$$

Where μ,σ,σ_{xu} are respectively the mean, variance and covariance of the images, and C1, C2 are stabilizing constants

Experimental Results

fig:3 Reshaped Gray scale image

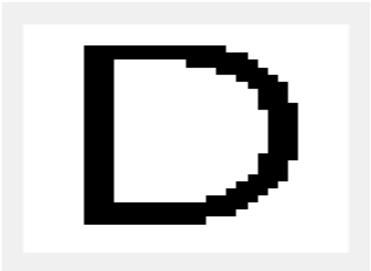


Fig:4. Extracted image after watermarking with α=0.5

Fig:5. Graph for quality factor and SSIM values

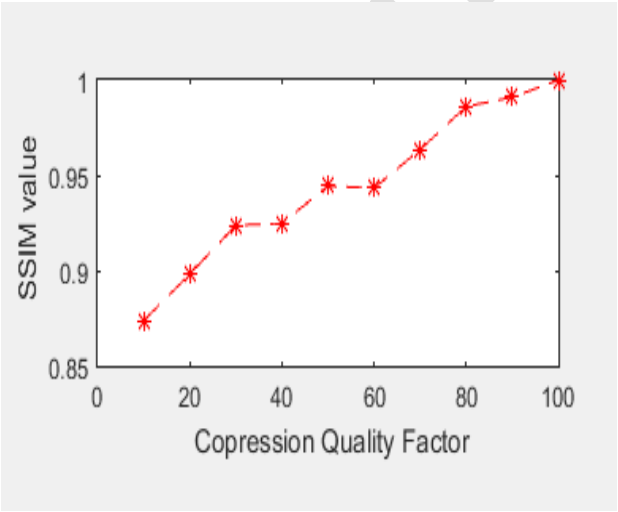


Table: A Comparative Study

Different Signals	SNR	SSIM	PSNR
Pop	0.0192	0.9988	62.3232
Jazz	3.0332	1	INF
loopy	0.1388	1	INF
classic	0.2802	1	78.2338

According to these results we obtain different values for different speech signals and each signal has different quality of the watermarked image when compared to the image watermarked technique based on DCT[3] and this based on PSNR computation. Whereas, according to SNR computation, the extracted watermark(the speech signal) obtained from the proposed technique, is with worse quality when compared to the extracted watermark obtained from the image watermarking technique based on DCT [3] and this due to reshaping of the signal. This results also shows that the proposed technique outperforms the watermarking technique proposed in[3] and this precisely when the JPEG compression attack is applied to the watermarked image. When using the tunning parameter α in case of applying the JPEG compression attack to the watermarked image .

Conclusion

In this paper we have proposed a new image watermarking technique using data modulation. This technique consists at first step in getting the first color in case of RGB image which is a two dimensional matrix. Then the Discrete Cosine Transform (DCT) is applied to that matrix and embedding the watermark signal into the DCT coefficients. This watermark signal is obtained after multiplying the speech signal (information to be embedded) by a tuning factor α and the obtained signal is then modulated using reshaping. The latter is the watermark signal to be embedded in the original image. After inserting the watermark signal into the host image, the inverse of DCT is applied in order to produce the watermarked asset. The extraction process is simply subtracting the original DCT coefficients

from the watermarked image ones. After extracting the modulated signal, it is demodulated and multiplied by 1/α, in order to recover the original signal. The obtained results from the SSIM, the PSNR and SNR computations, show the performance of the proposed image watermarking technique

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