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A Literature Review on Water Marking Techniques

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Abstract: image watermarking is a well known technique for copyright protection. This paper presents a review of the recently proposed watermarking techniques; and classifies the techniques based on different domains in which data is embedded. We have also analyzed the techniques in terms of their complexity, robustness and processing time. Finally a conclusion is drawn by classifying the techniques according to best suitable area of application according to their properties and requirements.

Keywords: Watermarking, image transforms, DCT, DWT.

1. Introduction

Digital watermarking is the process of embedding information into a digital signal which may be used to verify its authenticity or the identity of its owners, in the same manner as paper bearing a watermark for visible identification. In digital watermarking, the signal may be audio, pictures, or video. If the signal is copied, then the information also is carried in the copy. A signal may carry several different watermarks at the same time. Paul Levinson Future of the Information Revolution, where he called for the use "smart patent numbers", or the embedding of electronic chips in every piece of technology, which would give an updated listing of all of its inventors. In visible digital watermarking, the information is visible in the picture or video. Typically, the information is text or a logo, which identifies the owner of the media. The image on the right has a visible watermark. When a television broadcaster adds its logo to the corner of transmitted video, this also is a visible watermark.

In invisible digital watermarking, information is added as digital data to audio, picture, or video, but it cannot be perceived as such (although it may be possible to detect that some amount of information is hidden in the signal). The watermark may be intended for widespread use and thus, is made easy to retrieve or, it may be a form of steganography, where a party communicates a secret message embedded in the digital signal. In either case, as in visible watermarking, the objective is to attach ownership or other descriptive information to the signal in a way that is difficult to remove. It also is possible to use hidden embedded information as a means of covert communication between individuals.

One application of watermarking is in copyright protection systems, which are intended to prevent or deter unauthorized copying of digital media. In this use, a copy device retrieves the watermark from the signal before making a copy; the device makes a decision whether to copy or not, depending on the contents of the watermark. Another application is in source tracing. A watermark is embedded into a digital signal at each point of distribution. If a copy of the work is found later, then the watermark may be retrieved from the copy and the source of the distribution is known. This technique reportedly has been used to detect the source of illegally copied movies.

Annotation of digital photographs with descriptive information is another application of invisible watermarking.

While some file formats for digital media may contain additional information called metadata, digital watermarking is distinctive in that the data is carried right in the signal.

2. Spatial Domain Techniques

This section particularly describes the watermarking techniques which don't use the domain transformation hence the embedding is performed directly on image data. Spatial domain watermarking, in general, is easy to implement on computational point of view but too fragile to withstand large varieties of external attacks, but still there are many proposals available which minimizes its drawbacks. Some efficient techniques are discussed in rest of the sections.

A robust, computationally efficient and blind digital image watermarking in spatial domain has been proposed by Santi Prasad Maity & Malay Kumar Kundu [1]. In their technique watermark insertion process exploits average brightness of the homogeneity regions of the cover image. Spatial mask of suitable size is used to hide data with less visual impairments and recovery process needs only one secret image.

Their experimental results show that the intersection of watermark reduces the PSNR to 41.40 dB so the change in cover image is not detectable by human eyes. Results also shows that it can sustain the different attacks like the mean filtering of the image which degrade the image up to PSNR of 23.80dB the watermark is still detectable with NCC (Normalized Correlation Coefficient) = 0.80, with Gaussian filtered image with PSNR=24.15dB the NCC = 0.88.the image

rescaling with PSNR=24.85 dB gives NCC = 0.87 and JPEG compression with CPR of 45 give the NCC = 0.958. The results shows the robustness of the proposed method although the time for embedding and retrieval is not provided but the operations used looks simple and it could be assumed a very fast technique. Another technique for embedding the binary image watermark with watermark security is proposed by in color image by Ibrahim Nasir, Ying Weng, Jianmin Jiang [2] they presents a new robust watermarking scheme for color image based on a block probability in spatial domain. A binary watermark image is permutated using sequence numbers generated by a secret key and Gray code, and then embedded four times in different positions by a secret key. Each bit of the binary encoded watermark is embedded by modifying the intensities of a non-overlapping block of 8*8 of the blue component of the host image. The extraction of the watermark is by comparing the intensities of a block of 8*8 of the watermarked and the original images and calculating the probability of detecting '0' or '1'. The experimental results shows that the embedding watermark reduces the PSNR to 39.12, and median filtering gives NCC = 1.0, the JPEG compression with ratio 1.5 and 2 gives NCC = 0.72 and 0.50 respectively, the rotation of 2 degree gives NCC = 1.0 and scaling to 92% gives NCC = 0.65. from the results it can be concluded that the [1] gives much better performance than [2] for most of the attacks although the [2] provides the facility for color images.

Spatial Watermarking Method, based on a Logarithmic transformation of An Encrypted embedded Mark is presented by Hassen Seddik, Mounir Sayadi, Farhat Fnaiech, and Mohamed Cheriet [3], In this method, two approaches are proposed: the first consists on satisfying the data hiding requirement by encryption the watermark before embedding it in the host image, and the second consists in an entire (8 bit) encrypted mark embedding after a logarithmic transformation is applied on it. The encrypted mark is embedded in the host image without exceeding the watermark perceptibility threshold. The experimental results are as follows for rotation of 5 degree the NCC = 0.83, cropping 50% give NCC = 0.99, scaling to 50% give NCC = 0.98, JPEG 90 give NCC = 0.76.

3. The Transform Domain Methods

In transform domain watermarking schemes the embedding is performed after transforming the image in to other domain. Generally these techniques uses discrete cosine transform (DCT), or discrete wavelet transform (DWT) typically provide higher image imperceptibility and are much more robust to image manipulations.

In these domain watermark is placed in perceptually significant coefficients of the image. However, DWT has been used more frequently in digital image watermarking due to its time/frequency decomposition characteristics, which resemble to the theoretical models of the human visual system [4]. In order to further performance improvements in DWT-based digital image watermarking algorithms could be obtained by jointing DWT with DCT. The reason of applying two transform is based on the fact that jointed transform could make up for the disadvantages of each other, so that effective watermarking approaches could acquire [4].

Based on above discussion Saeed K. Amirgholipour, Ahmad R. Naghsh-Nilchi [4] proposed an algorithm based on Joint DWT-DCT Transformation. A binary watermarked logo is scrambled by Arnold cat map and embedded in certain coefficient sets of a 3-level DWT transformed of a host image. Then, DCT transform of each selected DWT sub-band is computed and the PN-sequences of the watermark bits are embedded in the middle frequencies coefficients of the corresponding DCT block. In extraction procedure, the watermarked image, which maybe attacked, is pre-filtered by combination of sharpening and Laplassian of Gaussian filters to increase distinction between host image and watermark information. Subsequently, the same procedures as the embedding process is used to extract the DCT middle frequencies of each sub-band. Finally, correlation between mid-band coefficients and PN-sequences is calculated to determine watermarked bits. The experimental results show the reduction of PSNR after embedding the watermark reaches to 37.88 dB. The attack with Gaussian LPF gives the NCC = 0.97. The cropping attack at 9% gives NCC = 0.98 and scaling to 50% gives NCC = 0.76. The JPEG compression by 5 give NCC = 0.97. The results shows that the method does not affects image while maintains the quality of watermark after attack but it looks much complex which needs larger time and processing power.

Maha Sharkas, Dahlia ElShafie, and Nadder Hamdy [5] proposed dual digital image watermarking technique which incorporates two watermarks in a host image for improved protection and robustness. A watermark, in form of a PN sequence (will be called the secondary watermark), is embedded in the wavelet domain of a primary watermark before being embedded in the host image. The technique has been tested using Lena image as a host and the camera man as the primary watermark. The embedded PN sequence was detectable through correlation among other five sequences where a PSNR of 44.1065 dB was measured.

J.L. Liu et al. [6] proposed watermarking by modifying the original image in transform domain and embedding a

watermark in the difference values between the original image and its reference image, the proposed scheme overcomes the weak robustness problem of embedding a watermark in the spatial domain. Besides, the watermark extraction does not require the original image so it is more practical in real application. The experimental results show that the proposed scheme provides not only good image quality, but is also robust against various attacks, such as JPEG lossy compression, filtering and noise addition here the numeric values are not mentioned because the authors taken other measuring aspects than NCC.

John N. Ellinas [7] proposed a robust watermarking algorithm using the wavelet transform and edge detection. The watermark embedding process is carried over the subband coefficients that lie on edges, where distortions are less noticeable, with a subband level dependent strength. Also, the watermark is embedded to selected coefficients around edges, using a different scale factor for watermark strength, that are captured by a morphological dilation operation.

The experimental evaluation of the proposed method shows that the PSNR after embedding watermark still retains to 54 dB, and even after different the detection system produces response of 2*T where T represents the minimum value which confirms a valid watermark.

Xiaojun Qi [8] proposed An efficient digital watermarking technique. The proposed watermarking algorithm embeds a binary logo watermark by modifying the appropriate subband images in the wavelet domain. The qualified significant wavelet coefficients and their texture and luminance content across two different coarse scales (level 2 and level 3 wavelet decompositions) are utilized to determine the positions and the magnitudes to adaptively embed the digital watermark. The approach can effectively hide a robust watermark due to the exploitation of the characteristics of the human visual system. The correlations between the watermarked wavelet coefficients and the rearranged pseudo-random sequences yielded from the digital logo at these two scales are stored as side information. The watermark is detected by comparing the correlations between the wavelet coefficients and the watermarking code at level 2 and level 3 with the stored side information. The techniques reduce the PSNR up to 38 dB after embedding the watermark.

4. Conclusion

The overall study in this paper shows that the spatial methods are relatively fast and requires low resources and even they can provide comparable performance when compared for attack (only scaling and noise) resilience to transform domain methods but does not resilience with attacks like rotation, compression, blurring and filtering like Gaussian. Hence the transform domain method provides a much better option at higher processing cost.

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