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Discrete Wavelet Transform Based Watermarking Using Modified Matrix Encoding

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Abstract:
Conventional Robust Reversible Watermarking methods have limited robustness in extracting watermarks from the watermarked images destroyed by different unintentional attacks and some of them suffer from extremely poor invisibility for water marked images. It is necessary to have a framework to address these three problems and further improve its performance. It presents a novel practical structure, wavelet-area arithmetical quantity histogram shifting and cluster (WSQH-SC). Compared with conservative methods, WSQH-SC resourcefully constructs new watermark in addition to removal procedures by histogram shifting and clustering, which are important for civilizing robustness and reducing run-time difficulty in addition, WSQH-SC includes the property-inspired pixel adjustment to effectively handle overflow and underflow of pixels. This results in acceptable reversibility and invisibility. To increase its practical applicability WSQH-SC designs an enhanced pixel-wise masking to balance robustness and invisibility. It perform extensive experiments over normal, medicinal and artificial opening radar imagery to show the effectiveness of WSQH-SC by comparing with the histogram rotation-based and histogram distribution constrained methods.

Key words: *Discrete wavelet transform, k means clustering, Quantization, Robust reversible watermarking.*

1.Introduction

Several methods are implemented in image processing to recover the watermarked images. During the last decade we have witnessed the domination of digital media. As different to analogue, digital information are in many cases easier to manipulate, while the result can be reproduced infinitely without any loss of quality. The new digital reality provides users with many accommodations like high quality, manipulation of the context, creation of perfect duplicates, streaming over the internet etc. Nevertheless these technologies in combination with the World Wide Web enable the perfect copying and distribution of copyrighted material anywhere in the world with practically no cost. Therefore a significant problem of non authorized copying and distribution of digital media is raised. Also in certain cases the problem of authenticity and reliability is raised like in medical or military implementations.

Figure 1

Digital Watermarking is called to cope with some of these issues. film and evidence industry, as well as media manufacturing in general, undergo enormous financial wounded from piracy. Consequently there is an increasing interest in recent years in the area of Digital Watermarking. Digital Image Watermarking stands for embedding a signature signal, called 'watermark', in a digital picture, in order to prove possession, or make sure genuineness or integrity of a certain image.

A water marked image can sustain various attacks which ultimately could destroy our ability to perceive the watermark. When the watermark is still perceivable after some bother, the procedure is referred as healthy watermarking. Robust watermarking is usually used for patent manage. In the conflicting, easily broken watermarking is the case where the watermark is embedded to an image in such a way, that the most change of the picture, due to an assault, would make the watermark imperceptible

Fragile watermarking is usually used for genuineness check, or honesty test. At present most watermarking schemes perform poorly against geometrical attacks. The most common geometrical attacks are rotation, flipping, translation, aspect ratio change, resizing and crop. In many cases in order to handle geometrical attacks, watermarking schemes employ several synchronization methods. These methods usually try to identify the geometrical distortions and invert them, before the watermark detector is practical The recognition of the geometrical distortion is achieved by examining a registration pattern embedded along with the watermark in the host image. However the addition of the registration pattern to the data carrying watermark reduces the fidelity of the watermarked image, as well as the scheme's ability. Another flaw of this move toward is that usually all the watermarked images carry the same registration watermark. Therefore it is easier to discern the registration watermark by collusion attempts. Once found, the registration pattern could be removed from all the watermarked images, thus restrict the inevitability of any arithmetical distortion. Additionally these methods increase computational time substantially and in some cases perform poorly. In contrast, information that is embedded in the image is not modified by compatible format change or resaving, no bandwidth increase is necessary to converse the extra in order, and a better safety is obtain because the embedded information is inconspicuous and hardly noticeable. For increased safety, a clandestine key can protect the embed procedure. In addition to these compensation, lossless information embedding enable work of fiction stylish application such as lossless easily broken verification and erasable robust watermarking. Data embedding into high frequency sub bands cannot lead to better imperceptibility of marked image. Another problem with this scheme is that the flipped pixels are very visible and the distortion in the watermarked image, although erasable, may be offensive in many application. The problem with the visibility of the artifact can be partially alleviated by using a more sophisticated modulo addition.

1.1.Paper Organization

This paper is organized as follows: Section 2 introduces Related work. Section 3 introduces architecture. Section 4 presents Algorithms . Section 5.gives conclusions and directions for future work.

2. Related Work

During the past decade, Robust lossless data hiding (LDH) methods have attracted more and more attentions for copyright protection of multimedia in loss surroundings One of the significant supplies of the robust LDH methods is the reversibility, that is, the host images can be improved without any distortion after the hidden communication are detached. The reversibility is often certain by the embedding replica, which affects the presentation of the methods very much. Another obligation is to have a improved heftiness, which allows the LDH methods to be healthy adaptable to the lossless and lossy environment, e.g., JPEG compression. Robust lossless data hiding technique has been successfully applied to many commonly used image. This technique can be applied for semi-fragile authentication . That is, on the one hand, if the marked image does not alter at all, the concealed information can be extract out, and the unique image can be healthier precisely, and hence it is genuine. On the other offer, if the noticeable image goes through density to some amount, the concealed data can still be properly extract for semi-fragile authentication. Data extraction is actually the reverse process of data embedding. For a given marked image, first split it into non-overlapping blocks and then calculate the difference value α for each block in the same way as that in data embedding. In some cases, the pixel values in a block are very close to the ends of histogram, such as 0 or 255 in the 8-bit case. The modification of the pixel values may lead to over/underflow problem, which means the modified pixel values are beyond the range of [0,255]. Instead of using modulo 256 addition, propose a new technique to solve this issue. That is, if the pixel values only fall into one side of the histogram, shift the pixel value towards the other side to avoid the over/underflow problem. In the worst case, if there are some pixel values with the block, which are close to the both sides, respectively do nothing to the block, which means actually embed bit 0 to that block no matter the actual bit to be embedded is 1 or 0. The introduced error bit will be corrected by using ECC.

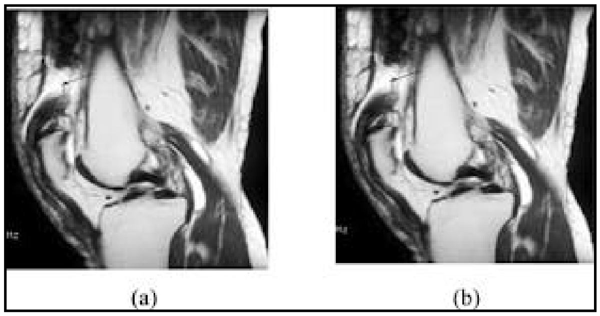


Figure 2

Consider the following 8 x 8 image block. This image block is split into two sets, called place A and place B. Set A consists of all pixels marked by '+' sign and set B consists of all pixels marked by '-' mark. Pixels in set A are denote by ai and the pixels in the set B are denoted by bi. That is each set has 32 pixels.For each block, calculate the difference value α. The difference value α is defined as the arithmetic average of difference of grayscale values of pixel pairs within the block. A pair is selected as the horizontally neighboring pixels.

$$\alpha = 1/n \sum_{i=1}^{n}(ai - bi)$$

where n is the number of pixel pair in the block. Since the pixel grayscale values in a local block are often highly correlated and have spatial redundancy, the difference value α. is expected to be very close to zero. The visual quality of the embedded image is very important factor for achieving the purpose of secret data delivery, that is, the embedded image with higher visual quality is easier to cheat unexpected users. Because the visual quality of images is subjective to human eyes observation, so the peak-signal-tonoise (PSNR) is used to evaluate the visual quality of an embedded image. PSNR is distinct by the subsequent equation

$$\text{PSNR}=10\times\log_{10} 255/MSE(\text{dB})$$

MSE is mean square error and used to evaluate the difference between a embedded image I' and the original image I. Here, the large value of PSNR means that the embedded image is most similar to the original image. In general, human eyes can not distinguish the distortion between an embedded image and the original image when the PSNR is above 34 dB. A novel robust lossless data hiding technique [6], which does not generate salt-and-pepper noise. By identify a strong arithmetical amount based on the patchwork theory and employing it to insert information, differentiating the bit-embedding process based on the pixel group's distribution characteristics, and using error correction codes and permutation scheme, this technique has achieved both losslessness and robustness. It has been successfully applied to many images, thus demonstrating its generality.

The experimental results show that the high visual quality of stego-images, the data embedding capacity, and the robustness of the proposed lossless data hiding scheme against compression are acceptable for many applications, including semi-fragile image authentication. Specifically, it has been successfully applied to authenticate losslessly compressed JPEG2000 images, followed by possible transcoding. It is expected that this new robust lossless data hiding algorithm can be readily applied in the medical field, law enforcement, remote sensing and other areas, where the recovery of original images is desired.

In the data embedding process, one may encounter the overflow/underflow problem, which means that after data embedding, the grayscale values of some pixels in the marked image may exceed the upper bound. This situation will necessitate the use of truncation, hence violating the principle of lossless data hiding. Therefore, avoiding overflow/underflow problem is a key issue in lossless data hiding. It is noted that modulo-256 addition is used to handle the overflow/underflow problem in achieving losslessness in this method. Therefore, this algorithm generates the salt-and-pepper noise. That is, in doing modulo-256 addition, a very bright pixel with a large grayscale value close to 255 will be possibly changed to a very dark pixel with a small grayscale value close to 0, and vice versa. When the algorithm is applied to a medical image. obviously, severe salt-and-pepper noise has been object served. The noise is so dense that the name “salt-and-pepper” becomes improper.

Medical images often contain many rather dark and/or rather bright pixels, hence suffering from severe salt-and-pepper noise. Not only for medical images, may the salt and-pepper noise be severe for daily-life images. It presents an example of a rather severe salt-and-pepper noise case on a color image, Woman. These algorithms is applied to the Red component of the image. The salt-and-pepper noise manifests itself as severe color distortion. Specifically, the color of a half of her hair area has changed from black to red, while the color of most of her right-hand palm area has changed from the flesh color to green. Note that authors also proposed an optional method in the same paper to overcome the salt-and-pepper noise.

A sequential recovery strategy is exploited for each pixel is reconstructed with the aid of its previously recovered neighbor. Experimental results and comparisons with other methods demonstrate our method's effectiveness and superior performance. To modify the histogram constructed based on the neighbor pixel differences instead of the host image's histogram. Many peak points exist around the bin zero in this histogram due to the similarity of adjacent pixel values. Besides, many zero points exist in both sides of the bin zero. Here the peak point refers to the height of histogram bin with the largest statistical value and the zero point means the histogram bin with zero value.

The modification of the pixel values may lead to over/underflow problem, which means the modified pixel values are beyond the range of [0,255]. Instead of using modulo 256 addition, we propose a new technique to solve this issue. That is, if the pixel values only fall into one side of the histogram, we may shift the pixel value towards the other side to avoid the over/underflow problem. In the worst case, if there are some pixel values with the block, which are close to the both sides, respectively we do nothing to the block, which means we actually embed bit 0 to that block no matter the actual bit to be embedded is 1 or 0. The introduced error bit will be corrected by using ECC.

To losslessly recover the hidden data and the original image, error correction codes (such as BCH code) are applied to correct the erroneous bits. To combat the burst error, which may fail our algorithm, we introduce chaotic mixing on the watermark matrix to spread the burst error evenly in the whole watermark matrix so that ECC can work effectively.

Data extraction is actually the reverse process of data embedding. For a given marked image, we first split it into non-overlapping blocks and then calculate the difference value α for each block in the same way as that in data embedding. If the difference value α is outside the threshold, then bit 1 is extracted and the difference value is shifted back, meaning that the pixel value of one sub-set is back to its original value. If the difference value α is within the threshold, then bit 0 is extracted and nothing is done on the pixel value of that block. In this way, we can extract the watermark and obtain the original image without any distortion.

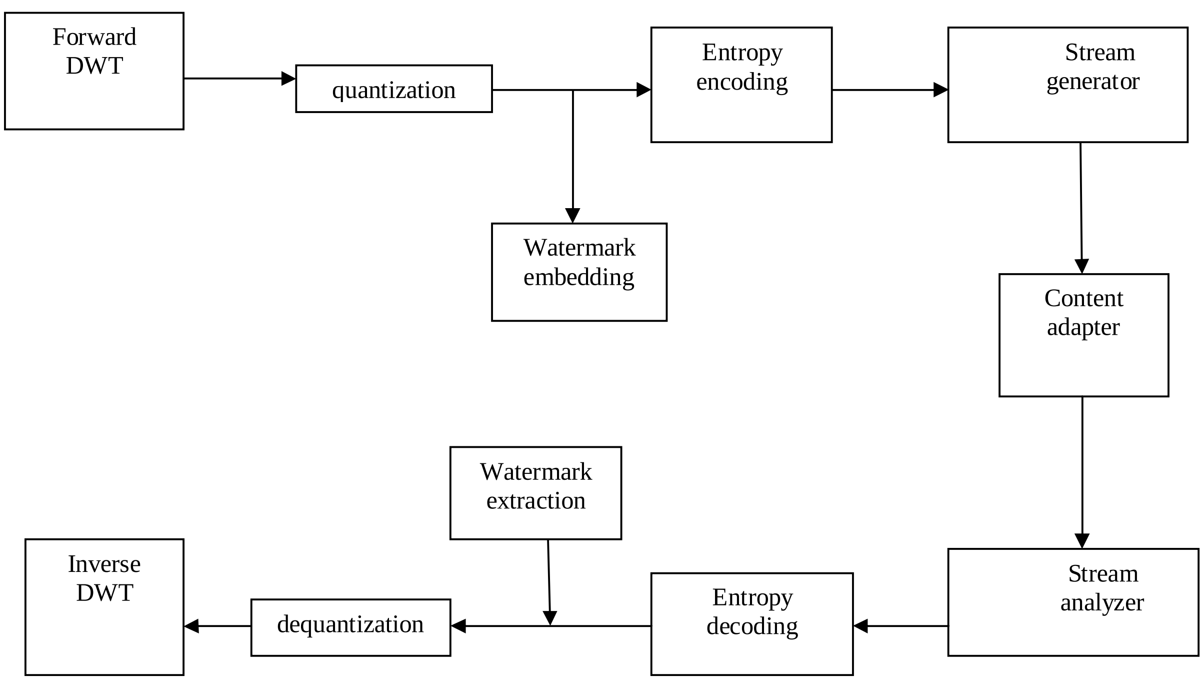
3.Problem Definition And Architecture

Robust reversible water marking (RRW) motivates the excellent spatio-frequency localization properties of wavelet transform, develop a novel RRW framework in the wavelet domain. This framework uses the statistical quantity histogram (SQH) as the embedding carrier inspired by previous work, the generalized SQH (GSQH) driven method, and constructs new watermark embedding and extraction processes by histogram shifting and clustering. In this framework, there are three key components, which are the property inspired pixel adjustment (PIPA), the SQH shifting and clustering, and the enhanced pixel-wise masking (EPWM), to effectively solve the aforementioned three problems.

The Robust Reversible Water Marking is a challenging task the essential objective to accomplish watermark embedding and extraction in both lossless and lossy environment. RRW is required to not only recover host images and watermarks without distortion for the lossless channel but also resist unintentional attacks and extract as many watermarks as possible for the noised channel.

The architecture diagram of the project is given below. Which describe the flow of the process..We are giving the input as the image and get the output as the original images and secret data.

That is the exact recognition of the original image and data.



So here we are apply two algorithms k means clustering and the effective watermark extraction algorithm.In the input there is high resolution images are present. After the quantization technique we are calculating the discrete wavelet co efficients and applying the clustering algorithm.Then hide the secrete data into the image produces the watermarked images. After that extracting the watermark from the image and store the secret data.

4.Algorithms

4.1.K Means Clustering Algorithm

K-means clustering is a method of cluster analysis which aims to partition n observations into k clusters in which each observation belongs to the cluster with the nearest mean. This results in a partitioning of the data space into Voronoi cells.

The problem is computationally difficult (NP-hard), however there are efficient heuristic algorithms that are commonly employed and converge quickly to a local optimum. These are usually similar to the expectation-maximization algorithm for mixtures of Gaussian distributions via an iterative refinement approach employed by both algorithms. Additionally, they both use cluster centers to model the data, however k-means clustering tends to find clusters of comparable spatial extent, while the expectation-maximization mechanism allows clusters to have different shapes

$$S_{k=}\begin{cases} sk - z - 1 \\ 0 \\ sk + z + 1 \end{cases}$$

where *brk*is the *k*th extracted watermark bit. Finally, thehost image can be recovered without distortion using the

inverse operation of (3) when the watermarked image is not degraded by unintentional attacks. Extensive experimental results suggest that the GSQH driven method has its pros and cons. On one hand, it combines GSQH and histogram shifting together to obtain good performance. On the other hand, however, it has three shortcomings: 1) it uses the AADs of all of the blocks, both reliable and unreliable, to generate the SQH of the host image, which increases complexity of watermark embedding; 2) it fails to consider the optimization of watermark strength; and 3) it suffers from unstable robustness against JPEG compression. By taking these pros andcons into account, we therefore integrate PIPA, SQH shifting, clustering, and EPWM into a novel RRW framework, which effectively overcomes the above shortcomings and makes our work intrinsically different from existing RRW methods.

4.2.Visual Masking Algorithm

Visual masking is the reduction or elimination of the visibility one brief (≤ 50 ms) stimulus, called the “target”, by the presentation of a second brief stimulus, called the “mask”. As a technique for studying the dynamic and micro genetic aspects of vision, masking rests on the following assumptions

An interval, on the order of a few tens to two or three hundreds of milliseconds, is required from onset of a stimulus to its measurable effects on behavior or its conscious awareness;The information conveyed by a stimulus is actively processed during this interval;The processing can occur in several specialized, multi-level visual pathways;The responses to the mask and the target can interact at specifiable levels of processing.

To better resist unintentional attacks, build SQH with threshold constraint by deeply studying characteristics of the wavelet coefficients, design the water mark embedding process by bi-directionally shifting SQH, and adopt the k-means clustering algorithm to recover watermarks by creatively modeling the extraction process as a classification problem. Besides from superior robustness, this way simplifies watermark embedding and extraction, and reduces the run-time complexity of the proposed framework.

4.3.Effective Watermark Extraction Algorithm

Image watermark extraction technique based on the iterative sparse blind separation algorithm (ISBS) and a new ISBS algorithm. The ISBS algorithm employs an lp norm based contrast function for blind signal separation. When the images are sparse or sparsely representable, a smooth approximation of the absolute value function is a good choice for the cost function. The NISBS algorithm employs the modeling of the distributions of sparse images using a family of convex smooth functions. Similar to the embedding process, we first decompose the watermarked image with 5/3 IWT and construct the MWC histogram by calculating the MWCs of blocks of interest in the sub-band $cHL0$. Let $Sw = \_Sw1 , . . . , Swm \_$ be the obtaine MWCs, $F = \_ f1, . . . , f\mu\_$ be the cluster centers, and $g = \_g1, . . . , g\mu\_$ be the set of clusters, wherein μ is the number of clusters.

If watermarked images are transmitted through an ideal channel, we can directly adopt the inverse operation of to recover host images and watermarks. However, in the real environment, degradation may be imposed on watermarked images due to unintentional attacks, e.g., lossy compression and random noise. Therefore, it is essential to find an effective watermark extraction algorithm so that it can resist unintentional attacks in the lossy environment.

$$F = \{\tau \min (Sw) , 0, \tau \max (Sw)\} \text{ for } \mu = 3,$$

α is a global parameter and $M \times N$ is the sub-band size. Because the novel embedding model shown in expands the additive spread spectrum to a reversible embedding model, we term it a generalized additive spread spectrum. By applying to the blocks of interest in the sub-band, watermarks can be embedded into the wavelet coefficients. Thereafter, the IWT reconstruction is performed to obtain the watermarked image.After the IWT reconstruction, the inverse operation of is applied to the pixels changed by PIPA in the embedding process to recover host images. As mentioned earlier, the side information including the block size, watermark strength, and locations of the pixels changed by PIPA, should be transmitted to the receiver side, which is important for the recovery of watermarks and host images.

5.CONCLUSION

This paper studied that a novel pragmatic framework for RRW have been used which includes PIPA, SQH shifting and clustering, and EPWM. PIPA reprocesses host images by adjusting the pixels into a reliable range for satisfactory reversibility. SQH shifting and clustering constructs new watermark embedding and extraction processes for good robustness and low run-time complexity. EPWM precisely estimates the local sensitivity of HVS and adaptively optimizes the watermark strength for a trade-off between robustness and invisibility. Improving image quality for the focus of our future work.

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