Lossless Image Watermarking for HDR Images Using Tone Mapping

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ABSTRACT
In this paper, a generic visible watermarking with a capability of lossless image recovery is proposed. This method based on the use of deterministic one-to-one compound mapping of pixel values a variety of visible watermarks on the cover image. The image conversion for watermarks normal image into HDR image are used in various image segmentation applications. During image conversion from watermarked into HDR image. The embedded watermark will be erased due to the usage of tone mapping in HDR image conversion. In this paper we have proposed a new technique for embedding a watermark which will not be erased during image conversion from normal image to HDR image. Our proposed system that, the original HDR image is transformed to a reference image by applying logLUV transformation. Finally the reverse log transform is applied to obtain the watermarked version of the given original image when a generic TM (Tone mapping) is applied to the watermarked HDR image, the watermark is still presents long as the assumption of similarly between the log transform and TM. The compound mappings are proved to be reversible, which allows for lossless recovery of original image from watermark image.

Keywords:
Lossless reversible watermarking, One-to-one compound mapping, HDR, Tone mapping

1. INTRODUCTION

Digital watermarking methods for image are usually categorized into two types: Invisible and visible. The first type aims to embed copyright information imperceptibly into host media. Method of the second type, on the other hand, yields visible watermarks which are generally clearly visible after common image operation is applied [1]. Embedding of watermarks either visible or invisible, degrade the quality of the host media not all reversible watermarking techniques guarantee lossless image recovery, which means that the recovered image is identical to the original, pixel by pixel [2][3]

In this paper, a new method for lossless visible watermarking is proposed by using appropriate compound mapping. The mapping is proved to be reversible for lossless recovery of the original image. The approach is generic leading to the possibility of embedding different types of visible watermarks in to cover image.

High Dynamic Range (HDR) image represent the radiance of scenes captured by a device or generated by an rendering system. Due to the wide dynamic of visible luminance, their pixel usually take floating point values and thus HDR image cannot be directly rendered by present-day-display. In fact, the original values must be adapted in order to fit the dynamic and color gamut of the target device. Tone mapping image keep some commercial and intellectual value because of their high quality despite their limited dynamic range and hence they are possible targets for misappropriation a possible solution is represented by data hiding techniques such as digital watermarking, which would try to embed in to any HDR image some kinds of information that should have to stay there in even after a tone mapping processing [4]. The original HDR Image is transformed to a reference image by applying RGB-to-LogLUV transformation. Then the algorithm embeds the watermark in LogLUV transformed image. Finally the reverse LogLUV transformation is applied obtaining the watermarked version of the given original HDR image. When a generic TM is applied to the watermarked HDR image, the watermark is still present as long as the assumption of similarity between the log transform and TM operators in the luminance component holds, that is it is assumed that can be obtained from through a mild nonlinear transformation against which the watermarking process is robust

The watermark embedded in the resulting image of proposed system, survives any subsequent TM process. The transformation RGB-to-LogLUV since the inverse LogLUV transform is available, it allow as to obtain back the HDR watermarked image.

2. RELATED WORK

Embedding of watermarks, either visible or invisible, degrade the quality of host media in general. A group of techniques, named reversible watermarking [5][6] allow legitimate users to remove the embedded watermarks and restore the original content as needed. However, not all reversible watermarking technique guarantees lossless image recovery which means that the recovered image is identical to the original pixel by pixel.

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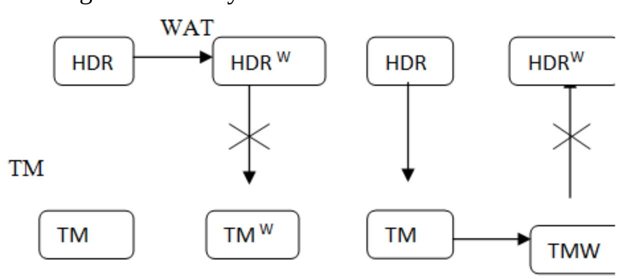
The most common approach is to compress a portion of the original host and then embed the compressed data together with the intended payload in to host [7][8][9]
In this section, we described the proposed approach to lossless reversible visible. Watermarking, based on which appropriate one-to-one compound mapping can be designed for embedding different types of visible watermark in to image. The original image can be recovered lossless from a resulting watermarked image by using the corresponding reverse mapping.

3. PROPOSED WATERMARKING ALGORITHM

1 Generic Visible Watermark Embedding
2 Generic watermarks Removal for Lossless Image Recovery

3.1 HDR Image Loading

The original image converted in to HDR image from watermarking process. HDR is an image processing technique that attempts to make pictures look more natural. The HDR image will load and display in the image panel, for original image reference, after loading the HDR image, the image has to ready for luminance conversion

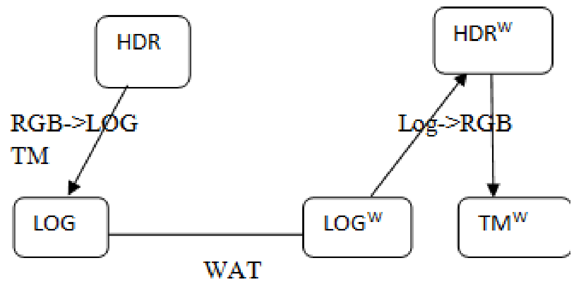


A) Image without Tone Mapping B) Image with the Tone Mapping.

3.2 LogLUV Conversion

The HDR image converted from RGB-to-LogLUV, the original image is transformed to a reference image by applying RGB-to-LOGLUV transformation. The log luminance value range is scaled to (0,255) as for 8 bit images. Then we get the LogLUV image for watermark embedding process.

3.2.1 Watermark
The watermark embedding consists of the quantization of the feature value using one of two possible scalar quantizes, one In our case, it is a scalar quantity , whose application does not affect either imperceptibility or robustness given that it is derived exclusively from the secret key and it is independent from the host feature value.



Using the LOGLUV reference image to approximate Tone Mapping

Given a kurtosis feature value, the corresponding watermarked feature value is expressed by

$$h = Q_{\Delta}(k - d\Delta) + d\Delta$$

Where k is the original feature value is the quantized value, Δ is the quantization step QΔ (.), is the quantization operator, with quantization step Δ as parameter, and d is the codebook shift. The shift d is extracted from a uniform distribution [-1/2, 1/2] in and then multiplied by Δ. Previous counter-shifting of the original feature value is necessary to ensure that h is the nearest reconstruction point. Therefore, the secret key K associates with each block a codebook shift uniformly distributed in the quantization interval.

3.2.2 Reconversion
In this module the water marked Luminance image is reconverted to HDR Image. Applying LogLUV-to-RGB transformation. The log-luminance values range is scaled to [0,255] as for 8-bpp LDR images. Then we get the LogLUV image for watermark embedding process.

3.2.3 Tone Mapped Image
Tone mapping reduces the dynamic range, or contrast ratio, of the entire image, while retaining localized contrast (between neighboring pixels), tapping into research on how the human eye and visual cortex perceive a scene, trying to represent the whole dynamic range while retaining realistic color and contrast. Images with too much tone mapping processing have their range over-compressed, creating a surreal low-dynamic-range rendering of a high-dynamic-range scene.

3.2.4 Reversible One-To-One Compound Mapping
First, we propose a generic one-to-one compound mapping for converting a set of numeric values for converting protection application investigated in this study, all the value p_i and q_i are image pixel value

(grayscale or color value) the compound mapping f is by one-to-one function f_x with one parameter x=a or y=b, where it is the inverse of f_x function.

Algorithm1: Generic Visible Watermark Embedding
Input: an image A and Watermark image W
Steps:

1. Select a set of pixel from A where W is to be embedded, and cell a watermarking area.
2. Denote, the set of pixel corresponding P to in by Q.
3. For each pixel X with value in P, denote the corresponding pixel in Q as Z.
4. Apply an estimation technique to derive a to be a value close to P, using the values of the neighboring pixel of X
5. Set the value of each remaining pixel in I, which is outside the region p to be equal to that of the corresponding pixel in A
6. Output: Watermarked image I

3.3 Lossless Visible Watermarking

Generic lossless visible watermarking scheme in the form of a class of one-to-one compound mapping, which can be used to embed a variety of visible watermarks in to image. The embedding is reversible to recover the original image lossless

Algorithm2: Lossless Image Recovery from Watermarked Image

Input: a watermarked image W and a watermark L
Output: The original image R recovered from W
Steps:

a. Select the same watermarking area Q in W as that selected from the original image

b. Set the value of each pixel in, which is outside the region Q, to be equal to that of the corresponding pixel in W.

c. For each pixel with value in Q, denote the corresponding pixel in the recovered image as X and the value of the corresponding pixel Y in L as l, and conduct the following set

i. Obtain the same value as that derived by applying

ii. the same estimation technique used to recover the image

iii. Set to be the value 1

iv. Restore from by setting p=Fa-1(Fb(a))

v. Set the value X of to be P.

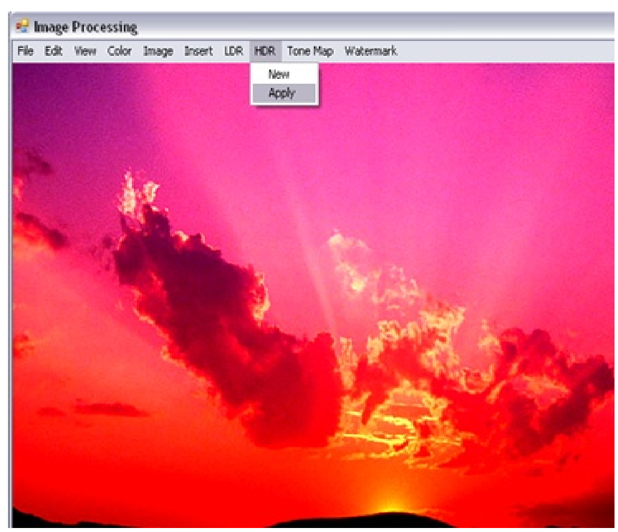
4. EXPERIMENTAL RESULTS

The High Dynamic Range pictures will give the images with higher resolution effects. In this paper, Figure -1 shows original image that is converted into the high dynamic format. After the conversion takes place the pixel values of the converted image is calculated. The figure- 2 is the converted image with their pixel values. Then, within this high dynamic range formatted image, the image that is to be watermarked is done. Now the figure -4 shows the original converted image with the embedded watermarked image.

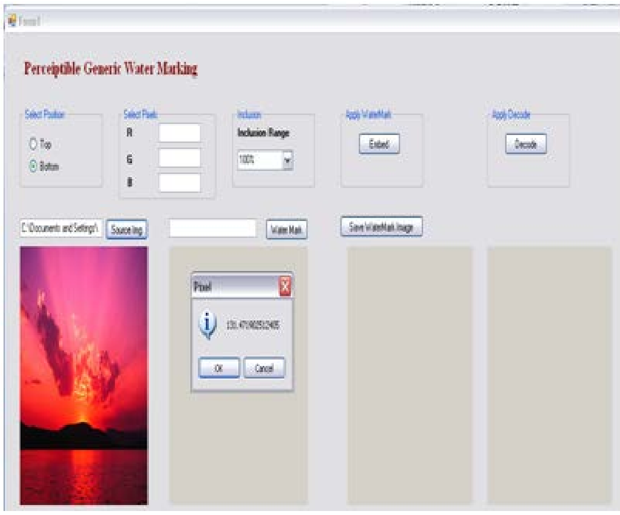
For the clear resolution effects of the watermarked image, the tone mapping technique is used to make the image to be clear. Then the original image is recovered from the watermarked image without any loss using the reversible watermarking technique.

(1) Original image

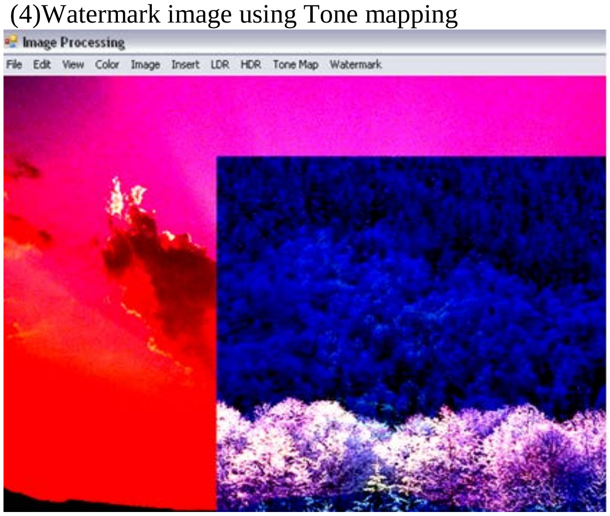
(2)Original image converted in to HDR image



(3)Original image pixel values

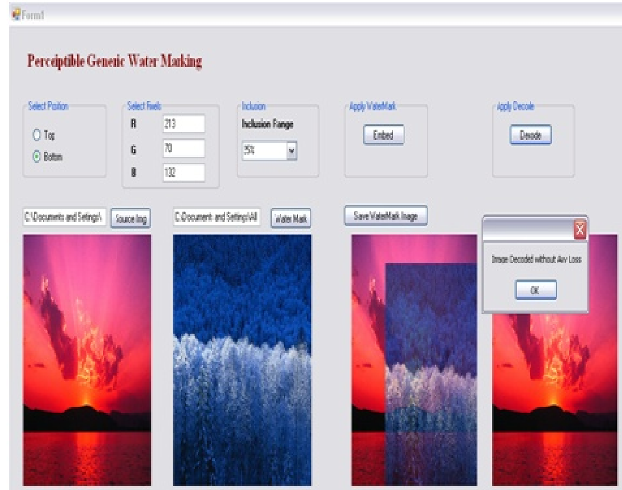


(4)Watermark image using Tone mapping



(5)Original image embedded in to watermark image

(6)Original image recovered from the watermark image without any losses.



5. CONCLUSION

In this paper, a new method for reversible visible watermarking with lossless image recovery capability has been proposed. The method uses one-to-one compound mappings that can map image pixel values to those of the desired visible watermarks. To demonstrate the reversibility of the compound mappings for lossless reversible visible watermarking. In this paper, we presented an algorithm for an HDR image detectable watermarking system with the requirements of imperceptibility and robustness. Experimental results have proven to be very good, especially considering how the design parameters have been set on a single image and then employed for the entire test database. The watermarks embedded using our system has always been detected, with the exception of the cases where the given algorithms have given visually unsatisfactory output images. The system has also been compared to a basic spread-spectrum watermarking algorithm operating in the same domain. As a final result, it could be interesting to switch to nonblank watermarking, which will probably be another likely applicative scenario for HDR image watermarking. This would allow us to choose which blocks to use for embedding, avoiding those difficult to watermark, to this aim, an extensive study of feature variability could be of great aid in determining in which zone of the image the watermarking system is more effective.

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