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RESEARCH ARTICLE

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COLOR IMAGE WATERMARKING BY BLOCK SELECTION USING LUMINANCE METHOD

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ABSTRACT

In this paper a new watermarking scheme is presented based on log-average luminance. A colored-image is divided into blocks after converting the RGB colored image to YCbCr color space. A monochrome image of 1024 bytes is used as the watermark. To embed the watermark, 16 blocks of size 8X8 are selected and used to embed the watermark image into the original image. The selected blocks are chosen spirally (beginning form the center of the image) among the blocks that have log-average luminance higher than or equal the log-average luminance of the entire image. Each byte of the monochrome watermark is added by updating a luminance value of a pixel of the image. If the byte of the watermark image represented white color (255) a value α is added to the image pixel luminance value, if it is black (0) the α is subtracted from the luminance value. To extract the watermark, the selected blocks are chosen as the above, if the difference between the luminance value of the watermarked image pixel and the original image pixel is greater than 0, the watermark pixel is supposed to be white, otherwise it supposed to be black. Experimental results show that the proposed scheme is efficient against changing the watermarked image to grayscale, image cropping, and JPEG compression.

Keywords— Watermarking, Luminance, Gray-scale, log-average luminance, spatial domain

INTRODUCTION

Watermarking is the methods of embedding information like personal data or logo into digital contents like images, audio or video. It can be detected or extracted later to prove the correctness of the embedded information in the digital media. The watermarking is essentially used in copyright protection, ownership proving, and integrity verification [1].

The watermark can be embedded into the image in spatial domain or domain frequency. In spatial domain techniques the watermark is embedded directly into the pixel data. In frequency domain techniques the image data is first converted to frequency domain using transforms such as DCT, DFT, or DWT. The watermark is embedded to the frequency domain coefficients and then the inverse transform is performed to restore the watermarked image [2].

In our proposed system we are using a new watermarking scheme which is based on log-average luminance. It is a spatial domain watermarking scheme for colored images. In this we are using a monochrome image of 1024 bytes as watermark and we are performing watermark operations on colored images [3]. Initially we have to divide the colored

image into blocks after converting the RGB colored image to YC_bC_r color space. To perform the watermark embedding operation, 16 blocks of size 8*8 are to be selected and then are used to embed the watermark image into the colored image. We have to select required blocks by performing block selection operation [4]. In block selection operation, we'll select those blocks which have log average luminance higher than or equal to the log-average luminance of the entire image. if the byte of the watermark image represents white color, a value alpha is added to the image pixel luminance value otherwise alpha is subtracted. to perform the watermark extraction operation, the selected blocks are chosen as the above, if the difference between the luminance value of the watermarked image pixel and the original image pixel is greater than 0, the watermark pixel is supposed to be white, otherwise it is supposed to be black[5][6].

PRELIMINARY INVESTIGATION

Evaluation of project request is major purpose of preliminary investigation. It is the collecting information that helps committee members to evaluate merits of the project request and make judgment about the feasibility of the proposed project [7]. At the heart of any system analysis is detailed understanding of all important facts of the business area under investigation. The key questions are-

What is being done? How it is being done. How frequently does it occur? How great is the volume of transactions or decision. How well is the task being performed? Does a problem exist? If a problem exists, how serious is it? What is the underlying cause?

To answer the above questions, system analysts discuss with different category of person to collect facts about their business and their operations. When the request is made, the first activity the preliminary investigation begins. Preliminary investigation has three parts-

Request clarification Feasibility study Request approval Request Clarification:- An information system is intended to meet needs of an organization. Thus the first step is in this phase is to specify these needs and requirements. The next step is to determine the requirements met by the system. Many requests from employees and users in the organizations are not clearly defined. Therefore, it become necessary that project request must examine and clarified properly before considering system investigation. Information related to different needs of the System can be obtained by different users of the system. This can be done by reviewing different organization's documents such as current method of storing sales data, complaint data etc. By observing the onsite activities the analyst can get close information related to real system[8][9].

By reviewing the existing watermarking techniques, it is observed that one of the main drawbacks of these techniques is that either they generate non-perceptual watermark with lack of robustness or compromised output with good robustness but they are highly computational resource consuming. Hence, most of the present algorithms are not suitable for watermarking technique [10]. To be more specific, most of the algorithms are not very much robust. In general, such algorithms achieve robustness at the cost of imperceptibility. The main drawback of this kind of techniques is the difficulty to control the distortions caused by the watermarking process and hence it is difficult to obtain watermarked object with high visual quality. From these motivations, we plan to develop a technique in spatial domain which is robust, imperceptible, secure and suitable for small payload with high perceivable visual quality by considering not only objective assessment parameters but also subjective assessment parameters for quality measurement [11][12].

Watermark insertion and extraction

The watermark algorithm proposed is non blind watermarking technique i.e, in non-blind technique we have both the original as well as watermarked image and thus for extraction we will subtract the original image from the watermarked image. Therefore in case of blind technique we only have the watermarked image and we apply algorithms on that in order to obtain the watermark [13][14].

Watermark insertion into the color image

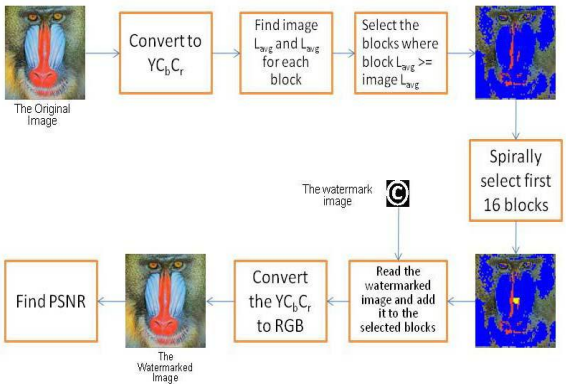

Fig. 1: The Embedding Process

- Convert the color image from RGB to Ycbcr.
- Then divide the image into the block size of 8*8.
- After that the block selection operation is performed.
- Select the first 16 blocks whose luminescence value is equal to or greater than the luminescence of the entire image.
- Embed the watermark i.e, monochromatic image.
- Convert image from Ycbcr to RGB.
- Save the resulting image

Watermark extraction from the watermarked image

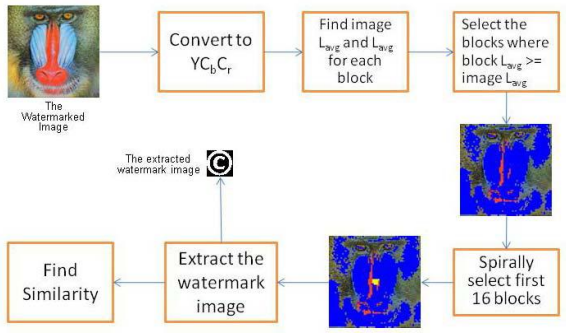

Fig. 2: The Extracting Process

- Convert the color image from RGB to Ycbcr.
- Find the log average luminance of both the images i.e, original and watermarked.
- After that the block selection operation is performed ie the blocks whose Log average luminescence value is equal to and greater than that will be selected.
- Select the first 16 blocks whose luminescence value is equal to or greater than the luminescence of the entire image.
- Extract the watermark i.e, monochromatic image.
- Convert image from Ycbcr to RGB.

Watermark Preprocessing

Usually scrambling transform is used in the pretreatment stage of the watermark as a way of encryption. Generally, a meaningful watermark image becomes meaningless and disordered after scrambling. For improving the security and confidentiality, a scrambling approach is used to encrypt the binary watermark image. After scrambling, human eyes cannot distinguish the shape of the original watermark. Without the scrambling algorithm and the key(s), the attacker will not recover the watermark at all even if it has been extracted from the watermarked image. So shuffling the image gives a secondary security [15][16][17].

D. Imperceptibility

A digital watermark is called imperceptible if the original cover signal and the marked signal are perceptually indistinguishable [18][19].

The watermark should not be noticeable to the viewer nor should the watermark degrade the quality of the content. The term imperceptible is widely used in this case.

However, if a signal is truly algorithms either introduce further modifications that jointly exceed the visibility threshold or remove such a signal, Gonzalez and Woods (2008). It is then important to develop techniques that can be used to add imperceptible or unnoticeable watermark signals in perceptually significant regions to counter the effects of signal processing [20][21][22].

E. Execution Time Comparison

The execution time of the proposed watermarking algorithms depends on the size of the color and, system configuration and also on the secure code which decides how and where pixels are selected for watermark embedding [23].

The execution time for watermark embedding is found to lie between 1.89 to 132 seconds for proposed algorithm, when executed on Pentium dual core 1.86 GHz processor. The algorithm

takes less time in execution as compared to other algorithm and produces output of better perceivable visual quality.

The proposed algorithm takes less time to insert the watermark when compared to other which reports 3.5 to 192.6 seconds when executed on Pentium-IV 3.4 GHz processor. The execution time for watermark insertion also depends on number, luminescence and positions of pixels to be watermarked.

Proposed Conversion Scheme For RGB to YC_bC_r Color Space

The proposed watermarking algorithm is non-blind in nature as it requires cover object as well as watermarked object at the time of extraction. The watermark information can simply be obtained by subtracting the pixels of the original image from the watermarked image. Thus we then obtain the watermark that we have inserted or embed in the original image.

The original 512*512 host image is divided into 8OE8 and each block is converted to YCbCr color space. The blocks which we select to embed are those having log-average luminance closer to the log-average luminance of the whole image.

The log-average luminance is calculated as per the method given in the step 2. DCT transform is applied to the Y component of each selected block. Each values of the watermark image are embedded into each selected block of the host image [24][25].

The watermark values are embedded in the DC component values of the selected blocks. The watermark is extracted from the watermarked image using the same selected blocks and DCT coefficients that have been used in the embedding process [25][26].

In YCbCr, the Y component represents the luminance (brightness), while Cb and Cr represent blue-difference and red-difference respectively.

Since the watermark is added to the luminance, the RGB color space of the image should be converted to YCbCr color space. The Y component is used later to embed the watermark Convert the RGB image int0 YCbCr color space using the following equations :-

Y = 0.299*R + 0.587*G + 0.114*B

Cb = 0.596*R - 0.275*G - 0.321*B

Cr = 0.212*R - 0.523*G - 0.311*B

Where, R, G, and B are red, green and blue components of RGB color space respectively[27].

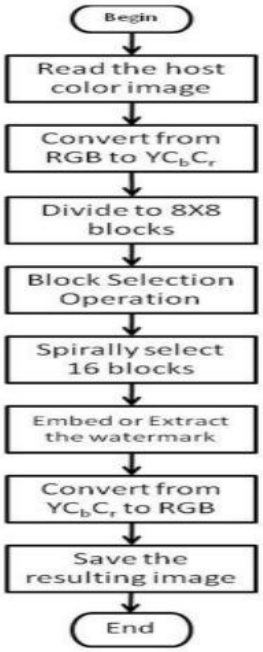

Fig. 3: The Embedding and Extracting Process

Conversion from RGB to YCbCr color space

Log-average Luminances

The block selection criteria are depended on log-average luminance for the entire image and log-average luminance for each block. The log-average luminance L_{avg} is calculated as shown in the equation:

$L_{avg} = exp(\sum log(d+Y_{x;y})/N)$

Where, L_{avg} is the Log-average luminance, Y(x,y) is the Luminance Y of the pixel at (x,y), delta is a small value to avoid taking the log of a completely black pixel whose luminance is zero and N is the number of pixels in the image[28].

Quality Measurement

Similarity measure is used to compare the extracted watermark W' to the originally embedded watermark W.

$$\sigma = \sum_{x} \sum_{y} S_{x,y}$$

$$\text{where } S_{x,y} = \begin{cases} 1 & \text{if } W'_{x,y} = W_{x,y} \\ 0 & \text{if } W'_{x,y} \neq W_{x,y} \end{cases}$$

The similarity σ varies in the interval [0, 1]; the value in the interval (0.5, 1.0] shows that the extracted watermark W' is matching the embedded watermark

W, this means that the original image has been watermarked with W [29].

Results

The results are produced from tests applied on different color images (girl, penguins). The block size is taken as constant (8x8). Figure1 show the quality measure PSNR and the Similarity for different images using different tests such as Cropping, JPEG compression, and changes the colored image to grayscale image.

Fig. 4: Image Before and After Watermarking

As we see, the similarity is not affected by image cropping and color image to grayscale conversion. In compression, the quality of the watermark is decreased as the compression factor is increased.

Tests are performed on different color images and show some robustness against various attacks. More robustness can be achieved by adding the watermark in frequency domain using transforms like (DFT, DCT, or DWT).

We also can use grayscale or color watermark instead of the monochrome watermark used in this paper.

It is observed that the distortion reduces by suitable selection of pixels. There is improvement up to 31.58% on numerical distortion as in shown.

The main requirement of watermarking algorithm is that it should not produce visible change over the color image.

IMAGES	PSNR VALUES
Baboons	62.499
Baby	51.834
Penguins	28.034
Peppers	19.623
Face	21.537
Tulips	60.765
Kola	27.4738
Chrysanthemum	12.638
Dessert	40.678
Jelly fish	25.0456

Fig. 4: Various Test on Different Color Images

CONCLUSION AND FUTURE SCOPE

In this paper, we proposed a non-blind, secure and robust watermarking algorithm in spatial domain. The proposed algorithm is based on the watermark is embedded in the selected pixels based on luminescence obtained from color image.

In the proposed algorithm insertion and deletion of watermark information is done in two different steps. The watermark is embedded by checking the luminance value of the block which constitutes the sixteen pixels of size 8*8, and then a monochrome image of size 32*32 is embedded. The proposed watermarking scheme is also robust against various distortion and distortion-less attacks. In case of distortion attacks like impressive, watermark is distorted to some extent. The execution time of watermarking scheme depends on the number of blocks and pixel's brightness selected for watermark embedding of color image. The execution time is found to lie between 2.84 to 208 seconds for different test objects when executed on Pentium dual core 1.86 GHz processor. Image Watermarking has become an important data authentication technique nowadays for image products. The proposed scheme can be used to watermark digital images without distorting the vital regions that are of interest to the customer. Hence, the value of the image is preserved. At the same time, the ownership of the digital image can be proven whenever required on the production of the key by the legal owner, thereby, keeping a check on illegal copying of the copyrighted image.

More robustness can be achieved by adding the watermark in frequency domain using transforms like (DFT, DCT, or DWT). We also can use gray scale or color watermark instead of the monochrome watermark used in this paper.

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