Digital Color Image Watermarking for HVS(Human Visual System) using Daubechies wavelet

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Abstract

The digital signal has been replaced the analog signal in most of every field of multimedia including still image, animation, and audio due to the enormous extension of computer supply and the fast development of computer network. The consumers of information are able to enjoy the abundance of information because of one of the digital signal traits that very easy to regenerate the original data. Because of the trait, however, it is very hard for the producers of information to keep the copyright with the merit of original copy in quality excellency.

In this paper, the watermarking technology which inserts a RGB color watermark in color image using the visual characteristics of wavelet coefficient was proposed.

As a result, the PSNR value of image was varied depending on perceptual parameter, but we can obtain 32dB as a whole.

Keyword

Watermarking, HVS, Wavelet, Information security, Digital image

I. Introduction

In order to activate the sound digital contents service, it is required to develop a system which is able to protect developer's copyrights, to prevent illegal reproduction, and to monitor illegal multimedia data (movie, music). Digital watermark is a technique used to insert additional information such as authority and authentication into original data corresponding to intellectual property rights, just like multimedia data and publication available for the network in order to protect intellectual property rights. Also, the digital watermarking technique is neede to be strong enough to protect original dta from external attacks so that the information producers using the digital watermarking technique can protest their ownerships[1].

Watermarking basically includes Adding Tags, LSB, quantization and technique based on DCT and DWT. In addition, it is divided into spatial domain insertion and frequency domain insertion according to domain into which watermark is inserted. It is also divided into Oblivious and Non-Oblivious method according to the necessity of original data when extracting watermark [2].

There are many color domains for expressing color image; however, major color domains used for expressing digital data include RGB, YUV (PAL), YIQ (NTSC), YCbCr(International Digital Standard) and YPbPr(HD Televisions)[3].

In this paper, we used the Daubechies wavelet filter(9/7) for copyright protection of digital color image among several kind of multimedia signals. And color image watermark of RGB mode inserted in original color image in low frequency area after do the Daubechies wavelet filtering.

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Also, the watermark do interleaving to have robustness in outside attack(Rotation, Cropping, Scaling).

II. Proposed Watermarking Algorithm

In this paper, we proposed the watermark algorithm that can insert a gray level logo image and a color(RGB) image. YCbCr color area that ICT (Irreversible Component Trans-formation) algorithm is applied made wavelet conversion using Daubechies 9/7 filter coefficients. Also, change watermark to YCbCr collar area. And wavelet conversion area of among in LSB (Least Significant Bit) area of frequency by Adding Tag technique insert .

2.1 Insertion algorithm

We proposed the watermark algorithm that can make insertion of the color watermark through the Image Preprocessing block and DWT conversion. Fig. 1 shows the total coding block diagram.

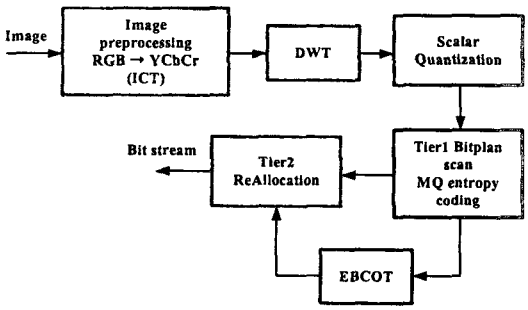

Fig. 1. Coding Block Diagram

The Image data that is converted to YCbCr in Image Preprocessing block change to low(L) and High(H) frequency ingredient using the Daubechies wavelet filter (9/7). From Original image can get data of ingredient (LL, LH, HL, and HH denote low-low, low-high, high-low, and high-high, respectively) such as Fig. 2 that is changed horizontality and verticality by wavelet filter. When insert watermark of gray level logo, do wavelet conversion only data of Y (brightness) ingredient. And make Y, Cb and Cr each ingredient wavelet conversion when insert color image watermark in original image.

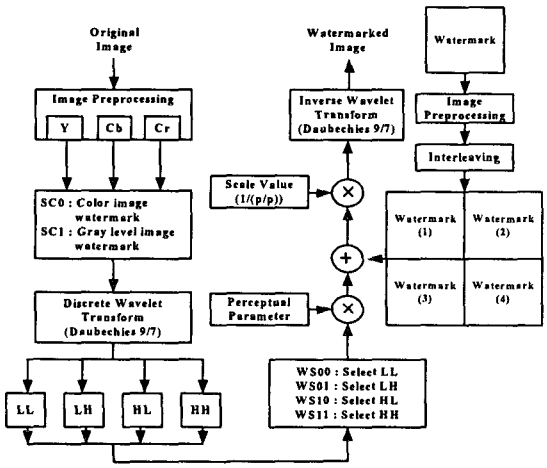

Fig. 2. The block diagram of watermark insertion

When wish to insert watermark of gray level to image data that passed the Image preprocessing block, apply only to the data of brightness ingredient in the watermark insertion algorithm of Fig. 2. Each areas of Y, Cb and Cr were divided 4 areas(LL, LH, HL and HH) by Daubechies wavelet filter(9/7). And the watermark is inserted into the selected area by Adding Tag method.

The p/p(perceptual parameter) has been applied to the area that watermark was inserted therefore image pixel value increase lineally. Thereafter, the relatively small pixel of watermark add to the selected image. And the image pixel which watermark was inserted, that is reduced lineally using p/p's reciprocal value. thereafter, If make inverse wavelet conversion, watermark is inserted in image.

The interleaving algorithm used in data communication is applied to watermark. The interleaving performed function effectively that can return it even if some of watermark image is lost by outside attack or noise by rearranging order of data.

If a pixel of watermark image has extended 4 pixels and insert the selected image, PSNR decreases because the amount of watermark data

increases but, that has robustness in outside attack(compression, filtering and crop etc.). Also, if apply the algorithm of bit expansion, reduction can heighten error correction rate by noise that is produced between data transmission[4].

2.2 Extraction algorithm

The watermark abstraction needs original image. Figure 3 shows watermark abstraction order.

Extraction of watermark follows below order.

1. The image that watermark is inserted processes the image preprocessing.
2. Confirm kind of watermark.
3. The area that watermark is inserted makes wavelet conversion.
4. Find the area of valid data whether was inserted in certain area among the image that is divided into 4 areas.
5. The P/P applies to select area that watermark was inserted.
6. Extract watermark to use difference with original image.
7. Reduce error rate of watermark applying de-interleaving.

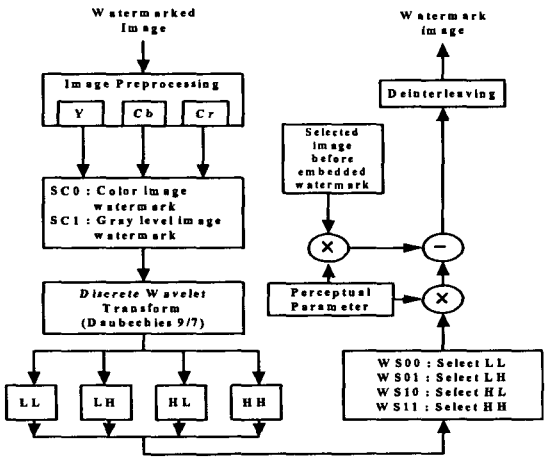

Fig. 3. The block diagram of watermark extraction

As a result, we must know kind of watermark for extraction watermark from watermarked image and whether was inserted to where among wavelet conversion area. Finally, we have original image. If this 3 condition is not filled, can not extract watermark.

III. Performance and robustness simulation

In wavelet transform block proposing in this paper , we used Lenna color image(512×512×3) for algorithm's performance measure. And inserted watermark used Chosun_logo image of 128×128 size of RGB color and 256 gray levels. The wavelet conversion area used in simulation for performance measure is LH area. In order to measured robustness and performance about outside attack (Cutting, Rotation, Modify PSNR, JPEG compression and Median Cut) using Bench marking Tool (stirmark 4_0_129).

Fig. 4. shows orignal image and watermark image which are used in performance measure.

(a) Lenna

(b) chosun_logo Gray

(c) chosun_logo Color

Fig. 4. Images used in performance measure

At first, the Chosun_logo Gray watermark is inserted with increasing P/P from 10 to 60 by 5. Fig. 5 shows watermark inserted image, extracted watermark and de-interleaving watermark when P/P is 60.

Fig. 5. Lenna image and extracted watermark

Also, table 1 is PSNR value of Lenna image that the Chosun_logo Gray watermark is inserted.

Table 1. PSNR value of Lenna image

P/P \ PSNR	Y(dB)
10	26.8253
15	30.3471
20	32.8459
25	34.7841
30	36.3677
35	37.7066
40	38.8665
45	39.8895
50	40.8047
55	41.6325
60	42.3883

Fig. 6 shows the comparison of robustness about JPEG compression used Lenna image.

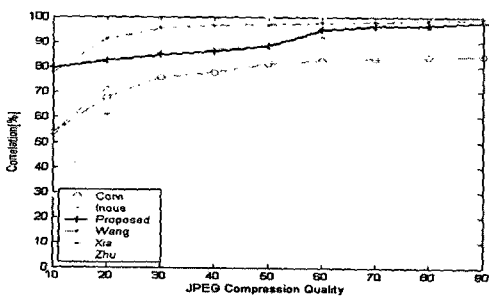

Fig. 6. compare performance(JPEG compression)

In Fig. 7, We can verify that robustness about Cropping attack is high than different algorithm because watermark insert to did interleaving.

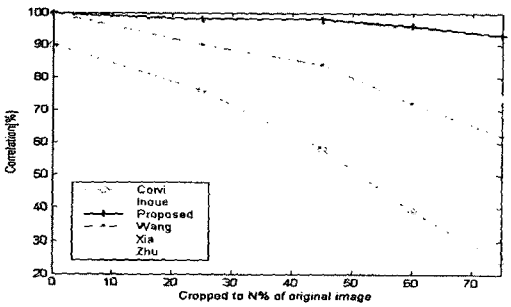

Fig. 7. Compare performance(Cropping attack)

IV. Conclusion

In this paper, we proposed watermaking algorithm that can insert a color image watermark and a image of 256 gray level watermak using wavelet conversion on the color still image. The proposed watermarking algorithm can insert watermark selectively in wavelet conversion area (LL, LH, HL, HH). According to inserted watermark area could know the point of difference that robustness about outside attack and PSNR. The robustness about outside attack is increased if insert watermark in low frequency area (LL) but PSNR is fallen. If insert watermark in high frequency area (HH), we could know that PSNR increases but that is weak in outside attack as like filtering.

The interleaving algorithm used in data communication is applied to watermark. Therfore data quantity of watermark increases, PSNR of image grows worse but the robustness about outside attack is improved. Also, according to P/P's increase, could confirm that distortion of image becomes low but distortion of extracted watermark becomes heavy.

When use color image watermark, amount data of inserted watermark increases but PSNR isn't big difference. We could confirm that visibility of extracted watermark is excellent

more than watermark of gray level. But, that is weak in compression and low frequency filtering.

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