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DIGITAL IMAGE WATERMARKING TECHNIQUES FOR IMAGES USING TWO-DIMENSIONAL WALSH CODING

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ABSTRACT

The Digital image watermarking technology is being improved day by day, there are a lot of possibilities of reproduction and manipulation of digital multimedia such as digital image, digital audio and digital video. Hence the digital image watermarking methods have been designed and implemented for the purpose of content protection and copyright management. In this paper, we present a robust and efficient digital image watermarking technique using 2-D Walsh coding. The 1-D Walsh coding was used to improve the robustness of digital image watermarking. In digital watermarking techniques, we discuss the various factors used in watermarking, properties and application area where watermarking technique required to be used. The digital watermarking is a passive protection tool that used to secure the data of researchers and the information is hidden inside a signal which cannot be easily detected by unauthorized users. In this algorithm some digits are embedded in image. The algorithm is blind and does not require the original image for extracting process. The digits were encoded by using 2-D Walsh functions and it was embedded in the low frequency coefficients of the discrete cosine transform of the host image. The performance of this technique is evaluated using Stir mark tool and results have been shown with the use of 2-D Walsh coding which is survived various attacks such as JPEG compression, noise, and different image manipulation algorithms.

Keywords: Digital Image Watermarking, Walsh Coding, DCT, Lena Image.

I INTRODUCTION

With the recent advanced technology of the internet, and the presence of the digital cameras, scanners and printers, people can easily exchanged data as per their needs. The digital media is commonly used in present era. These types of data, which includes images, videos, audios, or texts are stored and transmitted in a digital form via email attachments, multimedia messages (mms) or via Bluetooth can be easily copied without any loss of quality and efficiently as per original data. Hence, there is an urgent need to protect the copyright ownerships of these types of data. Hence Watermarking is a process of secure data from these threats. The information is stored in digital form due to ease of reproduction, retransmission and even manipulation allowed to pirate either to remove a watermark and violate a copyright or to cast the same watermark after altering the data to forge the proof of authenticity. The design of techniques for preserving the ownership of digital information will be the basis of the development of future multimedia services.

The digital watermarking has certain requirements, such as watermark must be invisible causing minimum distortion to the images, tolerant to normal image processing techniques such as JPEG compression, filtering and image manipulation techniques and robust against most of the signal processing operations.

The algorithms were used for watermarking can be classified according to the insertion domain. The watermark can be inserted in either the transform or spatial domain. The transform domain watermarking schemes are typically much more robust to image manipulation compared to the spatial domain schemes [1, 17, 18, 19]. One type of transform algorithms is the embedding of the watermark in the low frequency DCT coefficients and other is the use of 1-D Walsh coding before embedding.

In this paper, a new blind watermarking technique using 2-D Walsh coding is presented. The algorithm is used decimal digits as the watermarking information.

II DIGITAL WATERMARK ALGORITHM

A. Walsh Function

The Walsh functions is produced proportional to the value of the length elements while this length is in terms of 2n, where n is an integer. The Walsh functions consist of trains of square pulses with allowed states being –1 and 1. In this proposed method, the 2-D Walsh functions are used to encode the digits before being embedded in the host image. The summation of the 14 decimal digits is checked that the extracted number is correct or not. Each of the 14 decimal digits is converted into 4 bit binary number. Each bit of binary number is Walsh coded and then they are multiplexed. The size of the watermarking information is much smaller than the size of the image. The watermarking information is repeated several times using the shuffling technique.

B. Watermark Embedding:

The color image generally consists of three color Components red, green and blue. In new proposed technique, the RGB image is converted into Y, Cb, and Cr. The Y component represents the luminance information while Cb and Cr components represent the color information. The Y channel will be used as the host image to embedding the watermark. The watermark is embedded into DCT blocks of the Y channel by modifying the very low frequency band, excluding the DC component. Only Five low-frequency coefficients are used, by changing their values into even or odd numbers. This procedure is repeated for all other DCT blocks. The watermarked image is obtained by applying the inverse DCT process as shown in Figure 1.

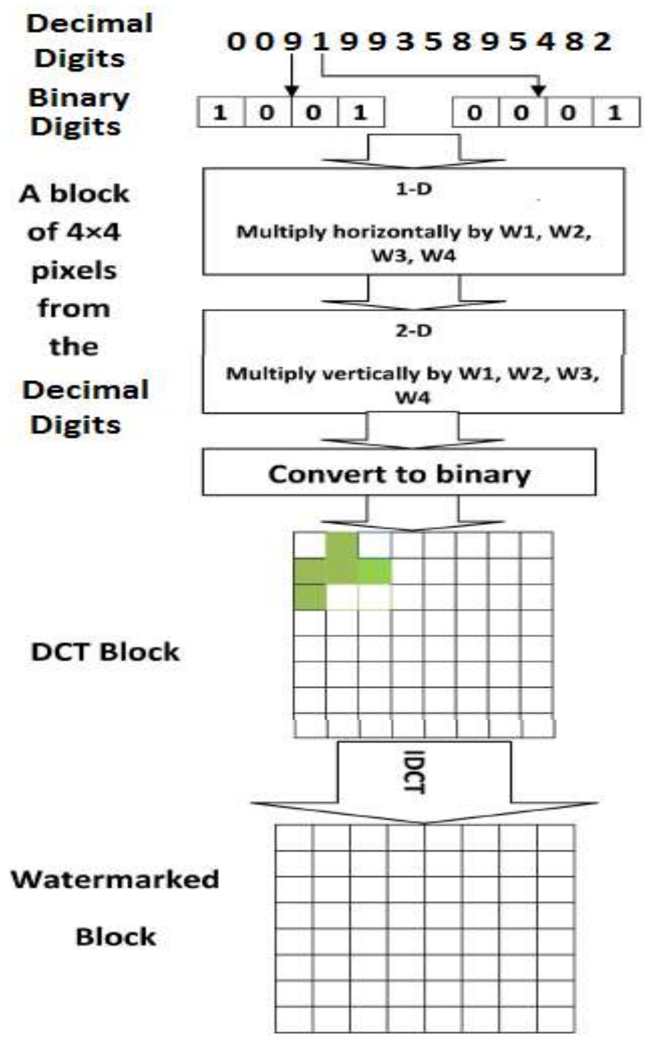

Figure1. Walsh coding of decimal digits

C. Watermark Extracting

In the extracting process, the watermarked RGB color image is converted into the Y, Cb, and Cr components. The Y channel is divided into 8x8 blocks and each block is converted into the frequency domain by using the DCT. Then the watermarked coefficients are located and checked to see whether they are even or odd and the Walsh coded watermark is extracted. Then the extracted information is decoded, the 2 check-sum digits are checked and the 14 decimal digits are recovered as shown in Figure 2.

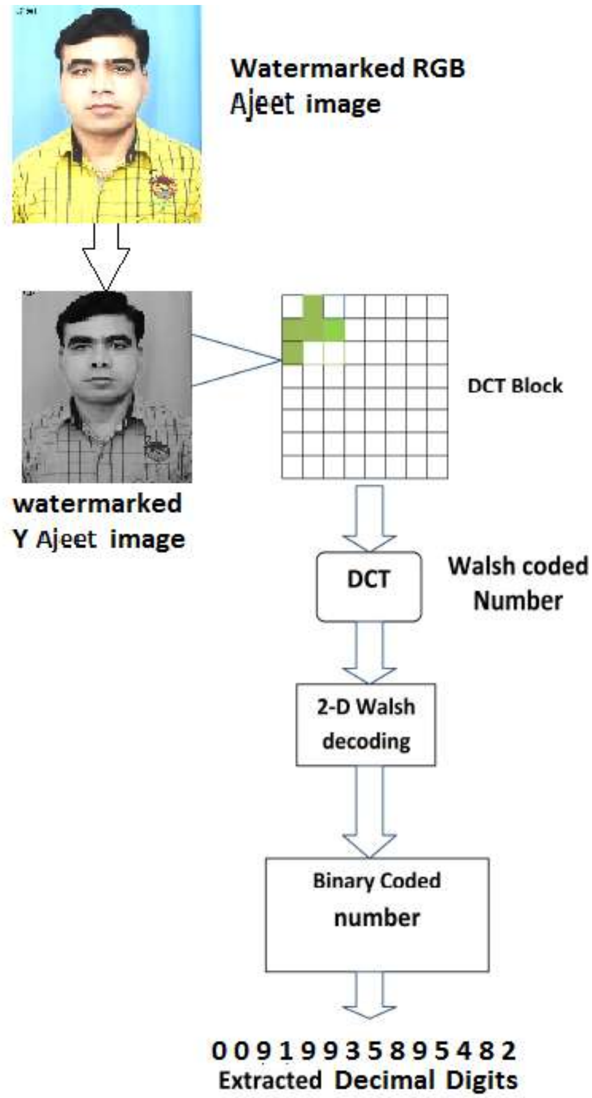

Fig. 2 Watermark Extraction of Decimal Digits

III EXPERIMENTAL ANALYSIS

For experimental purpose a new algorithm is tried on different types of images. Standard and non-standard 512x512 color images are used in the testing. Figure 3 shows samples of the color images that have been used in analysis. Due to the distortion, the watermarked images are assessed by using the peak signal to noise ratio (PSNR) and the structural similarity index measure (SSIM). It is clear that causes of the distortion the new watermarking scheme is invisible. The effect of the strength of the watermark on the distortion caused the watermarked images is studied. Table-I shows the effect on three different images.

Table-II shows the robustness of the new watermark algorithm to JPEG compression. These values are the minimum JPEG quality factors below these values the watermark cannot be recovered. Table-III shows the PSNR and SSIM without using Walsh coding. Table-IV shows the lowest JPEG quality factors without using the Walsh coding. It is clear that the use of the 2-D Walsh coding obtained better results compared to the case without coding. Table-V shows the different types of attacks using the Stir mark software. The proposed new algorithm survived JPEG and filtering attacks.

Walsh 2-D using Y Chanel		
Image Scale= 16	Original Image	Watermarked Image
Lena PSNR=37.6090 MSSIM=0.9375		
Ajeet PSNR=38.3143 MSSIM=0.9230		
Baboon PSNR=37.4639 MSSIM=0.9700		

Fig. 3 Original images and their watermarked versions

Table-I: PSNR and MSSIM with 2-D Walsh Coding

2D_WALSH CODED_ SSIM and PSNR		
Extracted decimal digits from baboon image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9995	55.4818
6	0.9954	45.9885
10	0.9878	41.5816
14	0.9764	38.5951
16	0.9700	37.4639
Extracted decimal digits from lena image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9988	55.5154
6	0.9897	45.9891
10	0.9728	41.5855
14	0.9506	38.7799
16	0.9575	37.6090
Extracted decimal digits from ajeet image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9982	55.5876
6	0.9868	46.5310
10	0.9390	42.2321
14	0.9390	39.4633
16	0.9230	38.3143

Table-II: The lowest JPEG factors with Walsh Coding, the watermark can be recovered.

Without Coding Y Chanel under JPEG attack	
Extracted decimal digits from baboon image	
Scaling factor	*JPG factor(Q)*
2	100
6	83
10	65
14	48
16	37
Extracted decimal digits from lena image	
Scaling factor	*JPG factor(Q)*
2	100
6	80
10	65
14	45
16	37
Extracted decimal digits from ajeet image	
Scaling factor	*JPG factor(Q)*
2	100
6	83
10	65
14	43
16	37

Table-III: PSNR and SSIM without using Walsh Coding

Without Coding_ SSIM and PSNR		
Extracted decimal digits from baboon image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9995	55.4951
6	0.9954	45.9150
10	0.9877	41.5852
14	0.9772	38.6686
16	0.9716	37.5644
Extracted decimal digits from lena image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9988	55.5247
6	0.9904	46.2005
10	0.9784	42.1584
14	0.9653	39.7005
16	0.9584	38.6562
Extracted decimal digits from ajeet image		
Scaling factor	*MSSIM*	*PSNR*
2	0.9984	55.9279
6	0.9919	47.8772
10	0.9817	44.0621
14	0.9708	41.5620
16	0.9642	40.5357

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Table-IV: The lowest JPEG factors where the watermark can be recovered.

WALSH CODED Y Chanel under JPEG attack	
Extracted decimal digits from baboon image	
Scaling factor	*JPG factor(Q)*
2	90
6	73
10	51
14	39
16	31
Extracted decimal digits from lena image	
Scaling factor	*JPG factor(Q)*
2	90
6	71
10	49
14	37
16	30
Extracted decimal digits from ajeet image	
Scaling factor	*JPG factor(Q)*
2	90
6	69
10	49
14	35
16	31

Table-V: The normalized correlation (NC) FOR Lena image under Stir mark attack at scale factor =16

2-D Walsh Coded_ NC at scale factor= 16	
Attack	*NC*
Additive noise 0.01	1
Additive noise 0.03	1
Additive noise 0.05	1
Additive noise 0.7	1
Additive noise 0.9	1
Affine_1	0
Affine_8	0
Conv_1	0
JPEG 20	1
JPEG 25	1
JPEG 30	1
JPEG 75	1
PSNR_30	1
PSNR_50	1
PSNR_70	1
PSNR_90	1
Median 3x3	0
Median 5x5	0
Rotation:0.1 degree	0
SS_1	0
SS_2	0

IV CONCLUSIONS

In this paper, we present digital watermarking scheme for color images using 2-D Walsh coding. The new scheme is used due to minimal distortion to the watermarking images. The PSNR values > 37dB and the SSIM values > 0.92 have been achieved with different types of images. It is found that the use of 2-D Walsh coding with DCT blocks provides high robustness against JPEG attacks compared to the embedding without coding. This new scheme is blind and the watermark can be extracted without the original image. The DCT domain watermarking can survive against the attacks such as compression, filtering, sharpening, and noising.

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