Watermarking in Medical Images Using Alpha Blending

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Abstract- *Development of computer network creates many benefits in digital imaging area which is used in medical imaging too. Networking facilities are available nowadays at low cost for this great advancement. But unfortunately this easy access provides virtually unprecedented opportunities to pirate copyrighted medical images. Some people want to maintain privacy in their medical information but unfortunately sometimes they are unable to do this. Watermarking is a technique that is very often used in medical image processing to trace copyrighted medical images. It can also be used to trace medical images which are illegally distributed without permission. A watermark is a pattern of bits inserted into a digital media that can identify the authorized users. In our research work, a new technique of visible and invisible Watermarking of medical images using alpha blending has been proposed. We have worked on color medical images which are watermarked with different values of alpha blending. This watermarking is actually done on each plane of the medical images. The resulting medical image contains the watermarked information of all medical images. Theoretically using this technique, multiple medical images can be watermarked, however to get a reasonably good output, we have worked with only two medical images, one is color and another is gray scale medical image. Using proper value of alpha, original medical image can be retrieved from the watermarked image. PSNR values are also calculated to check the robustness of the reconstructed image. Applying some post-processing work, this can be used in medical image steganography also.*

Keywords: Medical image, alpha blending, digital watermarking, PSNR, image security

I. INTRODUCTION

In medical image processing, there are wide application of Watermarking. Watermarking and image steganography are mainly used to hide an image using another image but there are few differences between watermarking and steganography. There are two different types of watermarking. An invisible watermark is an embedded image which normally cannot be traced with human's eyes. It can be extracted using special technique to identify the copyright owner. In general invisible watermarking can be done in either spatial domain or frequency domain. Whereas visible watermarking can be traced easily. There are many techniques used for medical image watermarking in both domains. Some particular selected techniques which are used for steganography that can be used for invisible watermarking too. A Patra et. al proposed a technique of watermarking using alpha blending. They have specially used their technique in visible watermarking. [1] David Ramirez et al launched a scheme for invisible color watermarking technique in anaglyph 3D images. They have inserted the image in the DCT domain using QIM-DM method. [2] P Sharma and S Swami used three level discrete wavelet transform for watermarking. In their method, they have used a technique where a multi-bit watermark is embedded into the low frequency sub-band of a cover image by using Alpha blending technique. During embedding, watermark image is dispersed within the original image depending upon the scaling factor of alpha blending technique. [2] Wieqi Luo et al. proposed a scheme using Edge Adaptive for image steganography and invisible watermarking. In this technique, edge adaptive scheme select embedding regions according to the size of secret image and the difference between two consecutive pixels of cover image. [3] Yan et al. proposed a watermarking approach to protect vector geo-spatial data from illegal use. [4] Chen et al. proposed a watermarking technique based on the frequency domain. They proposed to improve the defect of the JPEG quantification in order to reduce the bit error rate of the retrieved watermark. In Addition, two parameters called controlling factors are used to adjust the value of the DCT coefficient in order to trade-off the qualities between the watermarked images and retrieve watermark. [5] L Rajab et. al. launched a scheme applying two-level DWT to the video scene followed by Schur decomposition in which the binary watermark bits are embedded in the resultant block upper triangular matrix. In their scheme, the imperceptibility of the scheme is very high due to the use of discrete wavelet transform; therefore, no visual distortion is noticed in the watermarked video after embedding. [6] G Kaur et al have discussed least significant bit (LSB) for image watermarking in their technique. They have applied this technique in spatial domain only. Their technique is simple but is not applicable in frequency domain. [7]

In our proposed scheme, we have used one color medical image and one gray scale medical image. The gray scale medical image is used for watermark image. At first, the color medical image is divided into its three planes, Red Green and Blue. Using different value of alpha, we have changed the intensity values of each plane of color medical image and the gray scale medical image. During reconstruction, the particular plane of color medical image is replaced by the alpha blended image. In each case, PSNR and MSE values are to be calculated. We have applied the same process but the visibility of watermarking varies from plane to plane.

II. METHODOLOGY

Let us assume that selected medical images are a(x, y) and b(x, y) where a(x, y) is the color image and b(x, y) is the gray scale image which is used for alpha blending. Here three planes of color image a(x, y) is represented by ar(x, y), ag(x, y) and ab(x, y) respectively. At first, we have multiplied each pixel of red plane ar(x, y) of the color image a(x, y) by different values of alpha (α). The resultant image is represented by c(x, y). Similarly, each pixel of the second image b(x, y) is multiplied by alpha (1-α). The resultant image is represented by d(x, y). The sum total two multiplied images formed the blended image. It is represented by e. Same process is done with each pixel of green plane ag(x, y) and blue plane ab(x, y) of the color image a(x, y).
Mathematically we can write as,

$c(x,y)= a_r(x,y) * \alpha$ (1) for Red plane

or, $c(x,y)= a_g(x,y)*\alpha$ for Green plane

or, $c(x,y) = a_b(x,y)*\alpha$ for Blue plane

$c(x,y)=b(x,y)*(1-\alpha)$ (2)

Adding both equations (1) and (2), we get

$e = c(x, y) + d(x, y)$

or ,$e = a_r(x,y)*\alpha+b(x,y)*(1-\alpha)$ (3)

or $e = a_g(x, y)*\alpha+b(x,y)*(1- \alpha)$ (4)

or $e = a_b (x, y) * \alpha + b(x, y) * (1- \alpha)$ (5)

a(x, y) is a color image but ar(x, y), ag(x, y) and ab(x, y) are gray scale medical images. The sum total e is also a gray scale image. During reconstruction of the color medical image a(x, y), we have replaced one plane by e to get alpha blended medical color image. We have calculated PSNR (Peak signal to Noise Ratio) and MSE (Mean Square Error) using this formula,

$$\mathrm{PSNR} = 10 log10\ R2 / MSE \quad (6)$$

$$\mathrm{MSE} = \frac{1}{MN} \sum \sum [a(x, y) + b(x, y)]2$$

Value of R is taken as 255 in Equation no. 6. M and N denotes their usual meaning.

III. RESULT

We have worked with Matlab version 2009. The selected images are shown in Fig 1(a) and 1(b). Fig 1(a) represents the color image a(x, y) and Fig 1(b) represents the watermark image b(x,y). Fig 1(c-e) represents the red, green and blue plane of the color image a(x, y).

Fig 1(a)

Fig 1(b)

Fig 1(c)

Fig 1(d)

Fig 1(e)

We have first alpha blended with red plane ar(x, y) of the color image a(x, y). Value of alpha is taken from 0 to 1. Then we have replaced the red plane ar(x, y) with blended image. The output of each different value of alpha is shown in Fig 2(a-e).

$\alpha = 0.1$
Fig 2(a)

$\alpha = 0.3$
Fig 2(b)

$\alpha = 0.5$
Fig 2(c)

α = 0.7
Fig 2(d)

α = 0.9
Fig 2(e)

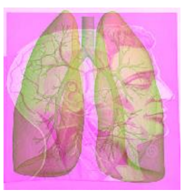
Then we have replaced the green plane ag(x, y) with blended image. The output of each different value of alpha is shown in Fig 3(a-e).

α = 0.1
Fig 3(a)

α = 0.3
Fig 3(b)

α = 0.5
Fig 3(c)

α = 0.7
Fig 3(d)



α = 0.9
Fig 3(e)

When we have applied the same process with blue plane of the color image, the output is shown in Fig 4(a-e)

α = 0.1
Fig 3(a)

α = 0.3
Fig 3(b)

α = 0.5
Fig 3(c)

α = 0.7
Fig 3(d)

α = 0.9
Fig 3(e)

IV. TABLE

Plane	***Alpha***	***PSNR***	***MSE***	***Plane***	***Alpha***	***PSNR***	***MSE***
	0.1	33.9	26	G	0.1	34.9	20
R	0.3	30.1	62	R	0.3	32	40
E	0.5	29.5	71	E	0.5	31.3	48
D	0.7	29.4	74	E	0.7	30.7	54
	0.9	29.3	75.	N	0.9	30.3	59

Plane	***Alpha***	***PSNR***	***MSE***
B	0.1	35.1	19
L	0.3	32.1	39
U	0.5	31.4	46
E	0.7	31.1	49
	0.9	30.8	54

V. CONCLUSION

The above mentioned technique can be used to maintain privacy of personal images. From the above result, it is clear that by using this simple process we can watermark any color medical image by performing alpha blending operation with one of its plane simplified manner. In our experiment, we have selected value of alpha from 0 to 1. By varying the value of it, we can highlight the main medical image (color image) from cover image. However, from the images it has been observed than blending with green plane of the color medical image is suitable for visible watermarking whereas blending with blue plane of the color image is suitable for invisible watermarking. In case of all plane, visible watermarking is possible for higher values of alpha but in case of blue plane, watermarking is not clear even in higher value of alpha. It is very clear that using low value of alpha, we can create invisible watermarked medical images. We have also observed that with the increase of alpha value, value of PSNR is decreasing for all planes but their MSE value is increasing. This technique can be used for Image Steganography purpose after some post processing work which will be discussed in future communication.

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