ijecs open access www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 2 Issue 4 April, 2013 Page No. 1250-1255

A Hybrid Watermarking Scheme For Medical Images

Mrs. Verma Deepti*, Mrs.Mishra Keerti,Mr.Verma R.L.
**Electronics Instrumentation and control Engg.deptt.*
Azad iet Lucknow
deepti.verma74@gmail.com

Electronics Instrumentation and control Engg.deptt.
Azad iet Lucknow

Electronics Instrumentation and control Engg.deptt.
Azad iet Lucknow

Abstract:
This paper introduces hybrid watermarking scheme for medical images. We propose a watermarking scheme that can recover the original image from the watermarked one. Medical images require special safety and confidentiality because critical judgment is done on the information provided by medical images. Transmission of medical image via internet or mobile phones demands strong security and copyright protection in telemedicine applications. In the field of telemedicine confidentiality of a medical image can be achieved by hiding the Electronic Patient Record (EPR data)in corresponding medical images. Technique named Class Dependent Coding Scheme [2] and the modified difference expansion watermarking using LSB replacement in the difference of virtual border. The payload is formed by image hashing using MD5 [1]. The proposed techniques aim at increasing the data hiding capacity, so it can be used to protect vary images like military or medical images. The paper discusses the perspectives of digital watermarking in a range of medical data management and distribution issues, and proposes a complementary and/or alternative tool that simultaneously addresses medical data protection, archiving, and retrieval, as well as source and data authentication. The scheme imperceptibly embeds in medical images multiple watermarks conveying patient's personal and examination data, keywords for information retrieval, the physician's digital signature for authentication, and a reference message for data integrity control. Experimental results indicate the efficiency and transparency of the scheme, which conforms to the strict requirements that apply to regions of diagnostic significance.

Key Words - **Reversible watermarking, difference Expansion, CDCS, virtual border, MD5.**

I. INTRODUCTION

Creations, copy, distribution and transmission of multimedia data have become common needs. Digital Image Watermarking provides copyright protection to digital images by hiding important information in original image to declare ownership. Perceptual transparency and robustness, capacity and blind watermarking are main features those determine quality of watermarking scheme [6]. Perceptual transparency means perceived quality of image should not be destroyed by presence of watermark. Robustness indicates resistance to different attacks like compression, scaling, rotation, cropping, noise attacks, sharpening, contrast adjustment etc. Perceptual transparency and robustness are two contrast measures. Hence, researchers strive for strongly robust with better perceptual transparency in watermarking schemes. The watermarking can be achieved either in spatial domain or in frequency domain.

In spatial domain, watermark is embedded by directly modifying pixel values of cover image. These algorithms are simple in implementation. But problems with such algorithms are: Low watermark information hiding capacity, Less PSNR, Less Correlation between original and extracted watermark and less security, hence anybody can detect such algorithms. The Frequency domain the watermark is inserted into transformed coefficients of image giving more information hiding capacity and more robustness against watermarking attacks because information can be spread out to entire image [1]. In number of medical applications, medical images require special safety and confidentiality, because critical judgment is done on the information provided by medical images. Critically ill or injured patients can be treated locally by effective and secured communication between remote hospitals and distant specialist [2]. Exchange of medical images between hospitals located in different geographical locations is a common practice now a day as shown in figure 1.

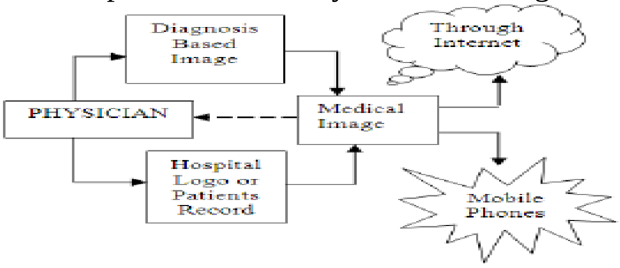


Figure1: Transmission of medical images from physician of remote hospital to specialist through internet and mobile phone.

The typical block diagram for medical image watermarking is given in Figure2.Here E embeds the watermark W in medical image to provide security and authentication. Decoder D extracts the watermark from watermarked image. By comparing the extracted watermark with original watermark, one can arm the tampering of medical image.

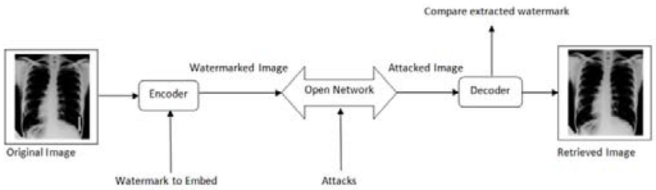


Figure2: Block diagram of Medical Image watermarking.

To ensure the reliability and quality of the watermarked image, the performance of watermarking is calculated, which measured in terms of perceptibility. There are two method of calculating the performance measure:
Mean Square Error (MSE):It is simplest function to measure the perceptual distance between water-marked and original image. MSE can be defined as:

$$MSE = \frac{1}{m * n} \sum_{i=1}^{m} \sum_{j=1}^{n} [I(i,j) - I'(i,j)]^2$$

Peak Signal to Noise Ratio (PSNR): It is used to measure the similarity between images before and after water-marking.

$$PSNR = 10 * \log_{10}\left(\frac{max_i^2}{MSE}\right)$$

where m: width and n: height;

I (i, j): original image pixel values at coordinate (i, j)

I '(i, j): compressed image pixel values at (i, j).
Here, MaxI is the maximum possible pixel value of the
image. When the pixels are represented using 8 bits per
sample, this is 255. For color images with three RGB
values per pixel, the definition of PSNR is the same except the MSE is the sum over all squared value differences divided by image size and by three. When the two images are identical the MSE will be equal to zero, resulting in an infinite PSNR [9].
From that formula, the PSNR of image is affected by

image size and the sum of differences. The bigger the size of the image and lower the sum of differences, the higher will be the PSNR.

II. PROPOSED METHOD: CDCS

This scheme works in two phases: the text processing phase and the image processing phase. In text processing phase stream of EPR encoded bits along with hash code bits are prepared and in image processing phase these bits are embedded into the RONI region of corresponding medical image.

Preparing payload

In this technique firstly Class Dependent Coding Scheme (CDCS) is applied on EPR data bits to reduce the size of EPR data bits and enhance the embedding capacity. The CDCS technique assigns fixed codes to each character according to their occurrence probability [12, 13]. In this scheme EPR characters are categorized into three different non-overlapping classes. Class A is considered to be most frequently appearing character set, Class B as an average frequency appearing character set and Class C as a less frequently appearing character set. The number of bits needed to represent each character in the respective class is calculated by assuming only capital letters, alphanumeric and few special characters. Then variable length code is designed to represent each class based on Huffman encoding. Using this scheme any character can be represented by only 4-bits prefixed by a class code (1-bit or 2-bit). CDCS combines the advantage of both fixed length and variable length coding to get less number of bits to represent same information.

Creation of Virtual Border and embedding a watermarking:

First step of watermarking is the making of virtual border. We use horizontal border and copy these border to obtain the mirror of first row and last row. It causes the Image's size growing. The difference of these mirrors issued to embed an image signature. Before embedding a watermark, the original image will be hashed using MD5.The result is a message digest of original image. Then it will be converted into binary as payload. Next, the payload is embedded using LSB in the difference of virtual border. In our method, we will embed the payload in the difference of virtual border. For a pair of pixels values (x, y) in a RGB image (24 bits), we can define the difference h as:

$$h = | x-y |$$

If we assumed that the higher value is called top and the smaller is called bottom, so we have

$$h = top - bottom, \text{ where } top >= bottom$$

To embed the payload, we use LSB (Least Significant
Bit) method and replace the last bit of difference with payload. It makes the chance of new difference only have two possibilities: equal or changes [1].The Flow Chart represents the Sequence of steps:

S. No	Filename	Size1	Size2	PSNR	MSE
1	abnl	694x599	694x601	88.0663	1.0150E-004
2	sonogram	256x168	256x170	77.5280	0.0011
3	bone	593x600	593x602	87.2891	1.2139E-004
4	head	640x496	640x498	86.3827	1.4956E-004
5	brain	446x599	446x601	83.0800	1.8902E-004
6	petct	606x599	606x601	87.1167	1.2630E-004
7	keosys	800x500	800x502	87.6366	1.1205E-004

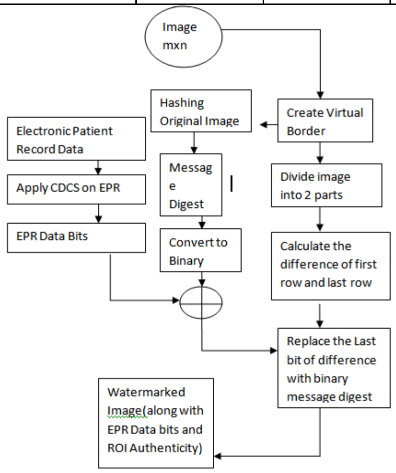


Figure 3: Flow chart for proposed methodology

III. Difference Expansion

This scheme usually generates some small values to represent the features of the original image. Then, we expand (enlarge) the generated values to embed the bits of watermark information. The watermark information n is usually embedded in the LSB parts of the expanded values. Then the watermarked image is reconstructed by using the modified values. The algorithm's steps are:

1. Take two adjacent pixel values of x and y
2. Find difference and average values of pixels
3. Then we expand into its binary form and add watermark bit right after most significant bit to get
4. Reconstruct the image using and d', we get the watermarked image .The similar process is required to be followed for the lossless recovery of the Original Image and the watermark [4].

Detection and Original Recovery: Watermark extraction and exact recovery of the original image is performed as follows:

1) Partition the entire image into pairs of pixels

2) For each pair

a) If the LSB is "1," extract the LSB of and store it into the detected watermark sequence, set the LSBs of, to "0," and recover the original pair by inverse transform .

b) If the LSB of is "0" and the pair with the LSBs set to "1"belongs to , extract the LSB of , store it into the detected watermark sequence, and restore the original pair as with the LSBs set to "1".

c) If the LSB of is "0" and the pair with the LSBs set to "1"does not belong to, the original pair is recovered by replacing the LSB of with the corresponding true value extracted from the watermark sequence.

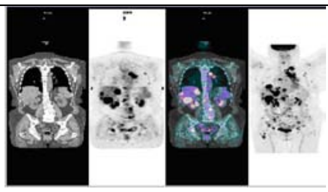
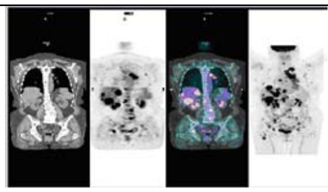
IV. Results

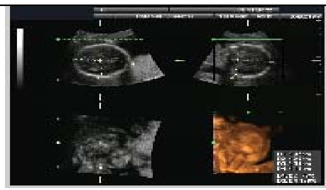
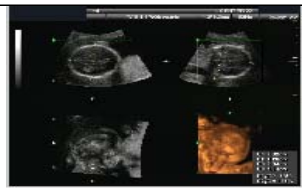
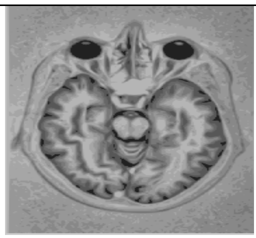
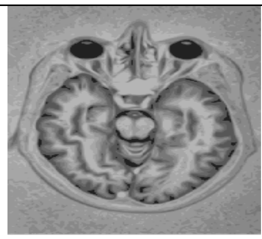
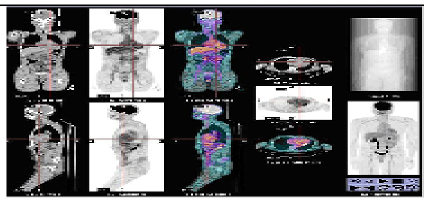
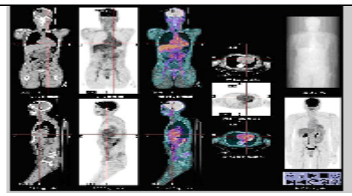
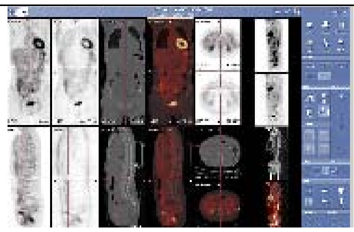
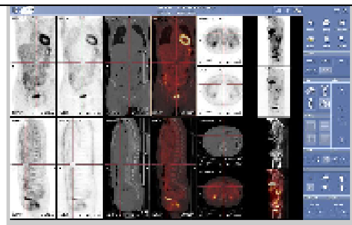
On applying the proposed technique to different set of medical images the computed values of PSNR and MSE are given in Table 1.

Table I

where size 1 represents size of the original image & size2 represents size of the watermarked image.

Table II

S.No.	Image Type	Original image	Watermarked image
1.	**abnl**		
2.	**sonogram**		
3.	**bone**		

4.	**head**		
5.	**brain**		
6.	**petct**		
7.	**keosys**		

V. CONCLUSION AND FUTURE SCOPE

In this paper, CDCS scheme has been proposed with the use of difference expansion and hashing algorithms. We have proposed easy to use authentication systems for the content authentication and copyright protection of medical images. This technique also provides flexibility to doctors in selecting the critical area of the medical image as ROI. The using of difference of horizontal virtual to embed image signature can make a small changes and it will not change the area of original image, so it can be used to watermark a sensitive image (i.e. medical image or military image) that can not allow a change, although it is a small change. The development of this method is still needed to increase the strength and watermarked image quality. The proposed system is expected to be effective for medical images in the sense that it is able to completely recover the original image at the receiving end after the authenticity of image is verified.

VI. REFERENCES

[1] C. W. Honsinger, P. Jones, M. Rabbani, and J. C. Stoffel, “Lossless recovery of an original image containing embedded data,” US Patent: 6,278,791, 2001.

[2] J. Tian, "Reversible watermarking by difference expansion, “Proceedings of workshop on multimedia and security, 2002, p. 19–22.

[3] Celik, M.U., Sharma, G., Tekalp, A.M., and Saber, E.: ‘Reversible data hiding’. Proc. ICIP, 2002, vol. 2, pp. 157– 160.

[4] Tian, J.: ‘Reversible data embedding using a difference expansion’, IEEE Trans. Circuits Syst. Video Technol., 2003, 13, (8), pp. 890–896.

[5] Z. Ni, Yun Q. Shi, N. Ansari and W. Su, "Reversible Data Hiding," IEEE International Symposium on Circuits and Systems, Bangkok, Thailand, May 2003.

[6] M. U. Celik, G. Sharma, A. M. Tekalp, and E. Saber, "Reversible data hiding," in Proceedings of the International Conference on Image Processing, pp. 157–160, NY, USA, Sept. 2002.

[7] J. Pan, H. Huang, and L. Jain, Intelligent watermarking techniques, Singapore: World Scientific Pub Co Inc, 2004. H. Munch, U.Engelmann, A. Schroter, H.P. Meinzer, "The Integration of Medical Images with the Electronic Patient Record and their Web- Based Distribution", Academic Radiology, Vol.11.6, 2004 ,pp. 661–668.

[8] Jasni Zain and Malcolm Clarke, "Security in Telemedicine :Issues in Watermarking Medical Images", 3rd International Conference on Science of Electronic, Technologies of Information and Telecommunications, 2005.

[9] B. Planitz, A. Maeder, "Medical Image Watermarking, "A Study on Image Degradation", Proc. Australian Pattern Recognition Society Workshop on Digital Image Computing, WDIC 2005, Brisbane, Australia, 2005.

[10] B. Macq, "Lossless multiresolution transform for image authenticating watermarking," in Proc. EUSIPCO, Sept. 2000,pp. 533–536.

[11] R. Munir, "Sekilas Image Watermarking untuk Memproteksi Citra Digital dan Aplikasinya pada Citra Medis,"International Conference on Telecommunication 2006, Bandung: 2006.

[12] Osamah M. Al-Qershi, Khoo Bee Ee, "Authentication and Data Hiding Using a Reversible ROI-based Watermarking Scheme for DICOM Images", World Academy of Science, Engineering and Technology 50 2009.

[13] Suresh N. Mali, Sunita V. Dhavale, "High Capacity Secured Adaptive EPR Data Hiding with Integrity Checking using CDCS", International Journal of computational sciences, vol.3 no6.December 2009, pp, 657- 668.

Table II