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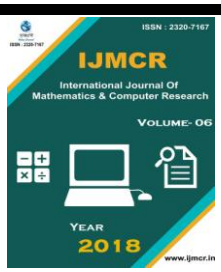

Analysis of Watermarking Techniques for Medical Images

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ABSTRACT

Telemedicine is a well-known application, where enormous amount of medical data need to be securely transfer over the public network and manipulate effectively. Medical image watermarking is an appropriate method used for enhancing security and authentication of medical data, which is crucial and used for further diagnosis and reference. This paper discusses the available medical image watermarking methods for protecting and authenticating medical data. The medical images can be transferred securely by embedding watermarks in RONI allowing verification of the legitimate changes at the receiving end without affecting ROI. The proposed algorithm is used to achieve maximum peak to signal noise ratio. The Proposed algorithm achieved for BPP 0.3, 0.55 and 0.7 and 0.8 are 50.02 , 59.27 , 48.34 and 46.25 respectively.

KEYWORDS: Segmentation, Authentication, security, medical confidentiality medical images; medical images watermarking; Reversible watermarking; algorithm intelligent

I. Introduction

In the last decades, uses of advanced electronic and digital equipment's in health care services areincreased. In fact, in most of the hospitals physicians diagnose their patients by relying on the provided electronic and digital data (such as Ultrasonic, Computed Tomography (CT), Magnetic Resonance Imaging (MRI) and X-ray images). This results in generation of large number of electro digital data (i.e. medical images) continuously at various health care centers and hospitals around the world. Image transmission causes a significant number ofproblems that are not solved till this time. Especially, medical images must fill several missions such as: Managing a huge amount of data, providing a good performance in compression and updating the services. These include the protection of content, privacy, integrity and authenticity of the images during transmission. Some medical applications require strict association between image and contextual data.

Exploiting image processing in medicine has garnered research attention. The deployment of PACS (picture archiving and communication systems) and electronic medical records require a greater security. According to coatrieux G et al. [1],

these security rules are based on three principles basics: privacy, reliability and availability. The confidentiality ensured that only authorized people can access the information. The reliability of the information should be understood as the association of a double check: integrity and authenticity of data. The image must not have been modified (integrity) voluntary or not since its acquisition or after any processingconsidered as part of a fully defined and known protocol. The image must also be consistent with patient identity (authenticity). The availability of the information system (maintenance, computer-call) for users is obviously the third safety rule. Firewall, access control, anti-virus, cryptography, electronic signature and software certification are the current guarantee of the integrity and confidentiality of medical data with human limitations and material that are known. The digital watermarking reinforces security for images data reliability by inserting annotation in the source image (authentication) and / or by inserting a signature of the source image (integrity). The watermarking can also integrates in the images a confidential data such as physiological information (ECG ...) and / or diagnostic, ensuring greater privacy to the patient data.

Digital watermarking is the technique of camouflaging covert information in another information named host/cover. Media files like video, text, audio and images can be utilized like cover information according to the media of implementation. Digital watermark can be united or in enciphered form or text, a logo or an image that is pertinent and linked to cover. In this process, we regard imperceptible watermarks only. In general, a watermarking scheme is divided in two basic steps: the embedding and extraction/detection.

Watermarking is different from steganography in the direction of embedding message known as watermark is linked to the cover or host. In the steganography process, any information can be camouflaged in the cover. The Cryptography improves security as an enciphered watermark is inserted in place of the original.

We can consider the Digital watermarking as a multidisciplinary topic, like; the mathematics, communication, information theory, the digital image and signal processing have led to in a major development in the watermarking technics. In the industry, the concept of digital watermarking allowed the digital age to flourish and gradually to replace the

analogue age and called as electronic watermark [2].

The rest of research paper is design as follows. The overall previous work is described in Section II. Section III describes the methodology used for proposedwork. Result analysis describe in section IV. Finally, Section V describes the conclusion of paper.

II. Previous Researchers

This section will provide the brief description and highlights the contribution, remarks and factorsof the work done by the researchers. Many attempts have been made in the past to achieve the maximum Peak signal to noise ratio while watermarking of medical images.

Yan Yan et.al (2017) studied watermark methods appropriate for medical images and conclude that the spatial watermark method such as LSB had the advantage that it did not damage the important information if the water mark was embedded outside the region of interest [1].

XinboGao et.al (2016) use an approach that allowsslightly more information to be embedded. A binary signature that consists of equal no ofzeros and ones is embedded in an image by assigning pixels into one of the two sets. Theintensity levels of pixels in one of the sets are altered. According to the authors, the degree ofcertainty can be as low as 84% and as high as 92%, which would likely not stand up asevidence in a court of law for copyright protection [2].

Ying-Shenet.al (2016) use to ralautomorphism to chaotically mix binary logos or signatures, which are added to a secret region in the image. The reconstructed watermark is recognized visibly if the watermarked is affected by JPEG compression up to 6:1. By using detection methods we can get a reliable answer about the existence or not of a watermark even if the watermarked image has been affected quite strangely by filtering and JPEG compression, greater then 10:1.compression) [3].

Kamran et.al (2015) have proposed an invisible image watermarking technique for image verification, where one is interested in knowing whether the content of the image has been altered since some earlier time. The technique provides a means of ensuring data integrity, adds to security of digital content and allows the recipients of an image to verify the image as well as to display the ownership information on the image [4].

Yiu-ming et.al (2015) has presented a spatial domain method which does not need the original for the purpose of extraction of the watermark. The scheme is robust to blurring, JPEG compression (75% quality factor), and geometrical operation [5].

Lu-Ting Koet.al (2015) model and analyze a watermarking scheme for copyright protection The results can be used to determine the threshold associated to a required probability, false probability of detection. They model the data-hiding process as communication channel [6].

Jun Tian et.al (2014) proposed a patchwork in which a watermark is embedded into the image by modifying the statistical property of the image. The inventors provide data that the recovery rate is 85% after JPEG compression, with quality parameter 75%, which is not likely stand up as credible evidence beyond a reasonable doubt in a course of law [7].

FeiPeng et.al (2014) presented an additive watermarking technique for grey-scale images. It contains in secretly embedding a binary code into the image without degrading its quality. The watermarking method is resistant to white noise, JPEG compression, low pass filtering and forgery [8].

Ming Chenet.al (2014) have presented an invisible spatial domain watermark insertion algorithm for which we show that the watermark can be recovered, even if the attacker tries to manipulate the watermark with the knowledge of the watermarking process. By making the image key and the intensity manipulation process specific for a buyer and with proper selection of error correcting codes, certain categories of collusion attacks canalso be precluded [9] .

V. Conotteret.al (2014) described method for embedding information in color images. A model of human color vision is used to ensure that the embedded signal is invisible. Sinusoidal signals are embedded so that they can be detected without use of original image. The embedded information is robust enough to be reliably extracted after being printed and scanned on common place equipment [10].

TalatNaheedet.al (2014) presented a method for marking high quality digital image with a robust and invisible watermark. The detection method presented exploits the not all understood but superb ability of the human visual system to recognize a correlated pattern in a scattered diagram called a “visualizer-coincidence image”. The watermarking scheme is robust to JPEG compression, printing and rescanning of the image [11].

III. Frame Work of Research

The main objectives of research work isto extract out the watermarked image. The main aim of this paper is to improve peak signal to noise ratio with respect to bit per pixel.

We initially implement a simple watermarking scheme which is based on cascading DWT with SVD for

comparison with the DWT, DCT and SVD method. DWT decomposes the image into four frequency bands: LL, HL, LH, and HH band. LL band represents low frequency, HL and LH represent middle frequency and HH represents high frequency band respectively. LL band represents approximate details, HL band gives horizontal details, LH provides vertical details and HH band highlights diagonal details of the image. In this proposal, we select HH band to embed the watermark because it contains the finer details and contributes insignificantly to the image energy. Hence watermark embedding will not affect the perceptual fidelity of cover image. Moreover, high energy LL band coefficient cannot be tweaked beyond certain point as it will severely impact perceptual quality.

The proposed scheme is replaces singular values of the HH band with the singular values of the watermark. Replacement of the singular values will not affect perceptual quality of image.

1) Watermark Embedding Algorithm:

i. Watermark W is decomposed using SVD W = Uw *Sw *VwT

ii. Apply DWT and decompose medical image into four sub-bands: LL, HL, LH, and HH.

iii. Apply SVD to HH band. H = UH *SH *VH T

iv. Replace the singular values of the HH band with the singular values of the watermark.

v. Apply inverse SVD to obtain the modified HH band. H‟‟ = UH *Sw *VH T

vi. Apply inverse DWT to produce the watermarked medical image.

vii. Pass HH band to extract original medical image.

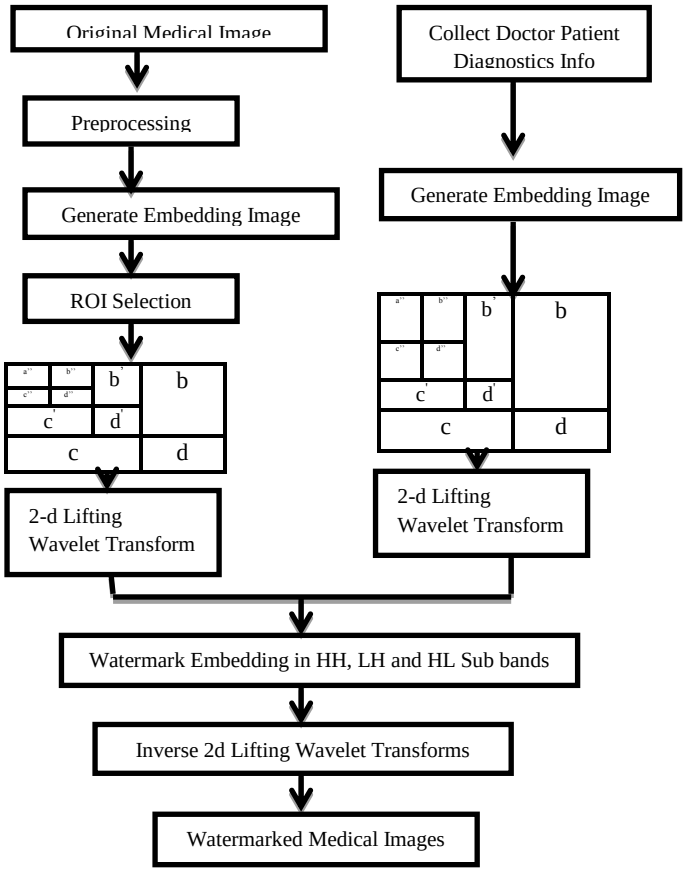

Fig 1 Proposed Flow Chart of the Process

2) Watermark Extracting Algorithm:

i. Using DWT, decompose the watermarked image into four sub-bands: LL, HL, LH, and HH.

ii. Apply SVD to HH band. H = UH *SH *VH T (10)

iii. Extract the singular values from HH band.

iv. Construct the watermark using singular values and orthogonal matrices Uw and Vw obtained using SVD of original watermark. WE = Uw *SH *VwT (11)

v. Reconstruct retrieved medical image by inverse DWT using HH band and rest band of watermarked image.

IV. Result Analysis

The proposed system has been applied against different type of medical image such as, CT scan, MRI, X-Ray & Ultrasound. We have tested the system over different size of medical images like 321 X 257, 387 X 387, and 513 X 513.

The applied watermark was consists of

1. Doctor's identity: G123467
2. Indexing for database: 321-123.2
3. Patient's identification: SweetyRana.190.85.04567852
4. Diagnosis Information: light sugar healthy extra spicy no fats 12189.75.2
5. Treatment applied to the patient:

The results after applying the system against CT scan, MRI, X-Ray and Ultrasound are shown below:

Figure 2 represent generated watermark Image of medical image to be transmitted.

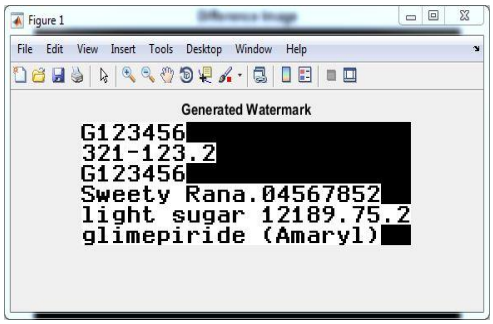

Fig 2 Generated Watermark Image

Figure 3 represent the input medical image for processing. The Input images have different pixels.

Fig 3 Input Medical Images for Processing

The segmented region of interest of medical image is shown in figure 4. In the particular result the watermark image is extracted out in the next step.

Fig 4 Segmented Region of Interest of Medical Image

Figure 5 representing original image after extracting watermarking. The grey level of image is decreased after exacting the image.

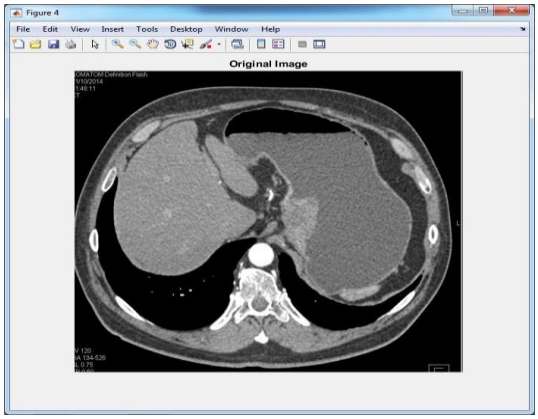

Fig 5 Original Image after extracting Watermarking

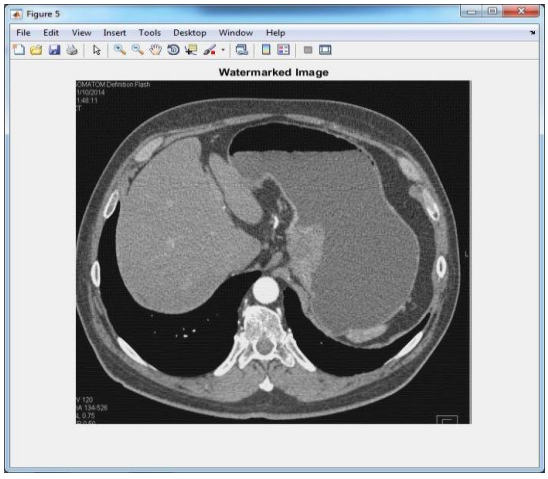

Fig 6 Watermarked Medical Image

Figure 6 & 7 are represents watermarked medical image and retrieved watermarked image after processing. The processing of watermarking is given by wavelet transformation.

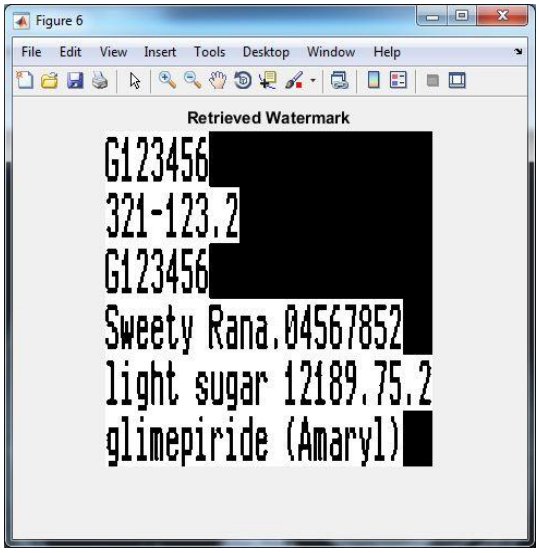

Fig 7 Retrieved Watermarked Image after Processing

The restorted Medical image is shown in fig 8. The content and information in the image is secure & preserve till the transmission.

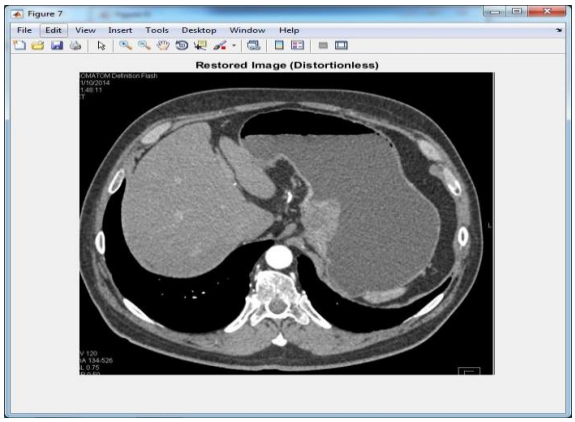

Fig 8 Restored (Distortion less) Medical Image

Comparative Analysis of different algorithm for Peak to Signal Noise Ratio is given in Table 1. The result shows that for 0.55 bpp peak signal to noise ratio achieved upto 59.27 db . The maximum achievement is done by proposed algorithm.

Table 1. Comparative Analysis of different algorithm for Peak to Signal Noise Ratio

bpp	Xuan	RIWA	EAP	H-GAWM	Proposed
0.3	43.5	45	50.8	49.008	50.02
0.55	41	41.1	46	47.587	59.27
0.7	39	40	41	44.913	48.34
0.8	-	-	38.1	44.069	46.25

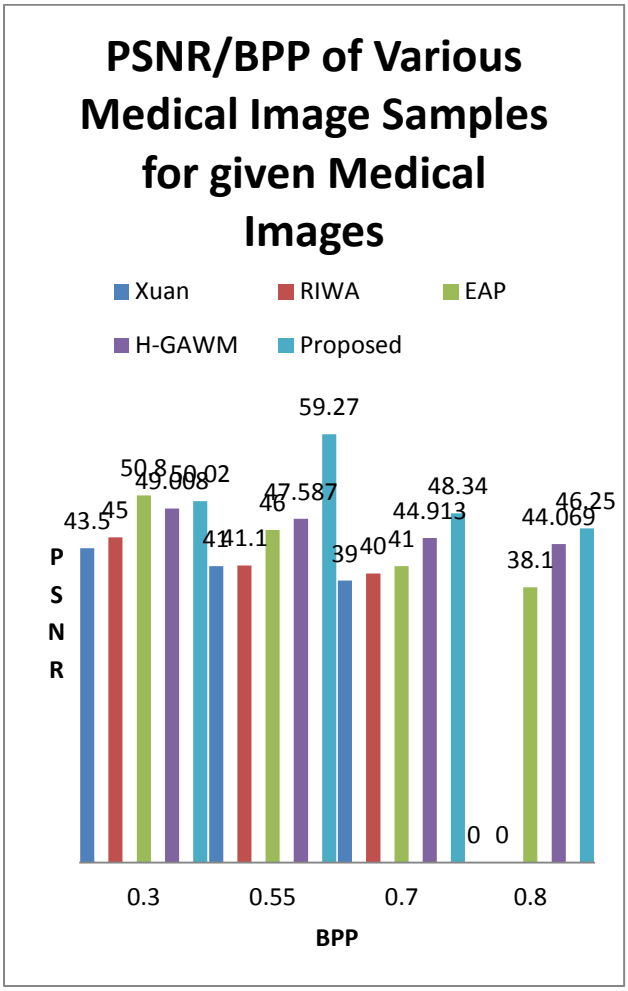

Fig 9 Comparative Analysis of different algorithm for Peak to Signal Noise Ratio

The graphical representation is shown in fig 9. Peak signal to noise ratio is achieved upto 59.7 db

V. Conclusion

There exist varied medical image water marking algorithms which offer the confidentiality of medical information, ill original image with none distortion, information integrity, authentication & economical information management. The proposed algorithm is used to achieve maximum peak to signal noise ratio. The Proposed algorithm achieved for BPP 0.3 , 0.55 and 0.7 and 0.8 are 50.02 , 59.27 , 48.34 and 46.25 respectively.

References:

1. Yan Yan, Yuan Sun, Huiqin Wang, Ying Lin and Haiyan Chen,"Reversible Authentication Scheme of Images based on Lifting WaveletTransform", Applied Mechanics and Materials Vols 278-280, pp 1379- 1382, 2017.
2. XinboGao, Lingling An, Xuelong Li, Dacheng Tao, "Reversibilityimproved lossless data hiding", Signal Processing, Volume 89, Issue 10,Pages 2053–2065, October 2016.
3. Ying-ShenJuang, Lu-Ting Ko, Jwu-E Chen, Yaw-Shih Shieh, Tze-YunSung, and Hsi Chin Hsin, "Histogram Modification and WaveletTransform for High Performance Watermarking", MathematicalProblems in Engineering, Article ID 164869, 14 pages, 2016.
4. Kamran, Asifullah Khan and Sana Ambreen Malik, "A high capacityreversible watermarking approach for authenticating images: Exploitingdown-sampling, histogram processing, and block selection", Volume256, Pages 162–183, 20 January 2015.
5. Yiu-ming Cheung, Senior Member, IEEE, and Hao-tian Wu, StudentMember, IEEE, "A Sequential Quantization Strategy for DataEmbedding and Integrity Verification", IEEE Transactions OnCircuits And Systems For Video Technology, VOL. 17, NO. 8, AUGUST 2015
6. Lu-Ting Ko, Jwu-E. Chen, Yaw-Shih Shieh, Hsi-Chin Hsin, and Tze-Yun Sung, "Nested Quantization Index Modulation for ReversibleWatermarking and Its Application to Healthcare InformationManagement Systems", Computational and Mathematical Methods inMedicine Volume 2015, 8 pages, 2015.
7. Jun Tian, "Reversible Data Embedding Using a Difference Expansion",IEEE Transactions On Circuits and Systems ForVideo Technology, VOL. 13, NO. 8, AUGUST 2014.
8. FeiPeng, Yu-zhou Lei, Min Long, Xing-ming Sun, "A reversiblewatermarking scheme for two-dimensional CAD engineering graphicsbased on improved difference expansion", Computer-Aided DesignVolume 43, Issue 8, Pages 1018–1024, August 2014.
9. Ming Chen, Zhenyong Chen, Xiao Zeng and Zhang Xiong,"Reversible image watermarking based on full context prediction", Image Processing (ICIP), 2014 16th IEEE International Conference on,7-10 Nov. 2014,
10. V. Conotter, G. Boato, M. Carli and K. Egiazarian, "High capacityreversible data hiding based on histogram shifting and non-local means",Local and Non-Local Approximation in Image Processing, 2009. LNLA2009. International Workshop on, Date of Conference: 19-21 Aug. 2014.
11. TalatNaheed, Imran Usman, Tariq M. Khan, Amir H. Dar andMuhammad FarhanShafique, "Intelligent reversible watermarkingtechnique in medical images using GA and PSO", Optik-InternationalJournal for Light and Electron Optics, Volume 125, Issue 11, Pages2515–2525, June 2014.
12. Thrasyvoulos N. Pappas and Robert J. Safranek, "Perceptual criteria forimage quality evaluation",

In in Handbook of Image and VideoProcessing, pages 669-684, Academic Press, 2014.

13. HabibaLoukilHadjKacem and Mohamed SalimBouhlel, “Mesure de laqualite des images par llutilisation de la loi de weber”, In InternationalConference : Sciences of Electronic, Technologies of Information andTelecommunications, 2013.
14. Vaishali S. Jabade and Dr. Sachin R. Gengaje, "Literature Review ofWavelet Based Digital Image Watermarking Techniques", InternationalJournal of Computer Applications (0975 – 8887) Volume 31 – No.1, pp.28-35, October 2011.
15. Sana Ambreen Malik, Asifullah Khan, MutawarraHussain, KhurramJawad, RafiullahChamlawi and Abdul Jalil, “Authentication of imagesfor 3D cameras: Reversibly embedding information using intelligentapproaches”, Journal of Systems and Software Volume 85, Issue 11,Pages 2665–2673, November 2012.
16. RuchiraNaskar and RajatSubhraChakraborty, “A generalized tamperlocalization approach for reversible watermarking algorithms”, JournalACM Transactions on Multimedia Computing, Communications, andApplications (TOMM) Volume 9 Issue 3, June 2013