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Medical Image Watermarking with Patient Details as Watermark

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Abstract— The Digital watermarking has been introduced for increasing the medical image security, confidentiality and integrity. The Medical image watermarking is a special sub-division of the image watermarking in the aspects that the images have some special requirements. The Medical image watermarking is an appropriate technique applied for increasing security and authentication of the medical data or information, which is very crucial and used for further diagnosis and future reference. This paper discusses the available medical image watermarking techniques for protecting and authenticating the medical data. The paper focuses on about the perceptual designing of the watermark for the digital images. The watermark designed perceptually is then embedded to the digital images in wavelet domain. A perceptual model is applied on to perceptually shape the watermark. This paper represents a primary study on the degradation of medical images when embedded with various watermarks, using a variety of the popular systems. The Image quality is measured with a number of widely used matrices, which have been used elsewhere in the image processing. The watermark before embedding can be compressed. This will lead to more secured and safely system. Also, it will take more effort to break the system. Consequently, the medical image watermarking remains an open field for the research and it appears that a selection of various watermarks for different medical image types is the most suitable solution to the generic problem.

Keywords: Image Watermarking, Medical Image watermarking, Steganography, Data hiding, DWT Transform.

I. INTRODUCTION

The speedy development of use of the Internet and the wireless networks provide easy access, exchange and handle of medical images. They also permit easy manipulation and replication. An Internet has been widely spread in many applications like online-banking, telemedicine, teleshopping etc. One of this application telemedicine is very crucial one, where internet is used to send or receive medical data by health-care professional. Due to recent advancement in information and communication technologies, a new context of easier access, distribution and manipulation of this digital data have been established [1].

In the past years, uses of modern electronic and digital equipments in health & care services are increased. In fact, in most of the hospitals physicians and doctors diagnose their patients by depending on the provided electronic and digital data (such as Ultrasonic, Computed Tomography (CT), X-ray images and Magnetic Resonance Imaging (MRI)). This results in the generation of large number of electro-digital information (i.e. medical images) continuously at different health care centers and hospitals around the world.

The Tele-medicine application contains the image transmission within and among the health care organizations via public networks. Some necessary requirements for the compression of the medical data include high compression ratio and the capability to decode the compressed data at different resolutions. The general summary that arises from the results is that typical watermark embedding can produce numerical and perceptual errors in an image. The greater the robustness of a watermark, the larger the errors are likely to be. In respective to provide a reliable and efficient means for storing and controlling the medical data, computer based archiving systems like Picture Archiving and Communication Systems (PACS) and Digital-Imaging and Communication in Medicine (DICOM) standards were then created. With the explosion in the number of images required for diagnostic purposes, the

importance of compression has become vital in the developing standards for maintaining and protecting medical images and health data records. Health Level Seven (HL7) standards are mostly introduced for exchange of textual information in health care information systems. One of the key issues with medical image watermarking is that medical images have special needs. A strictly requirement is that the image may not undergo any decomposition that will affect the reading of medical images. Generally, images are used to remain intact to achieve this, with no visible changes to their original form [2]. There has been a lot of research going on lossless data compression. The most popularly used lossless compression algorithms are run-length encoding, JPEG, LZW, DEFLATE, JPEG 2000, JPEG-LS, LOCO-I etc. Lempel–Ziv–Welch is the lossless data compression algorithm which can be used to compress images as shown in [3]. The Lossless compression in JPEG [4] is obtained by performing integer reversible DCT (RDCT) in place of the floating point DCT used in original JPEG on each block of the image by using lossless quantization. The details of these methods are given in [3].

The Medical images hold decisive property and are more crucial and important part of medical data. Such part of the medical image is known as Region of Interest (ROI). The ROI is very helpful in providing further diagnosis by the physician. For the copyright protection and authentication of the clinical images, digital watermarking is an emerging technique, which comprises the embedding and extraction process. In embedding process some secret/hidden information is embed in to medical images. The Extraction process deals with the extraction of secret/hidden message, which are embedded in the medical image. If any failure occurs in the extraction process then the physician would come to know that there has been any kind of tampering with that image, and he would take the appropriate precaution of not making the diagnosis based on that image. However, if the extraction process extracts the original and correct watermark, which generally consumes a few seconds, physician can continue with diagnosis.

II. LITERATURE REVIEW

The Medical image watermarking systems can be divided into three broad categories: robust, fragile, and semi-fragile. This section describes these terms and gives a brief review of existing systems in each category. The *Robust watermarks* are shaped to resist attempts to remove or destroy the watermark [4]. They are used preliminary for copyright protection and content tracking. Many of the traditional robust process are spread-spectrum, whereby the watermark is spread over a broad range of image frequencies [5]. More recent work involves the creation of image adaptive watermarks, where parameters vary depending on the local image characteristics [4]. A number of robust medical image watermarking systems have been developed.

The Fragile watermarks are widely used to determine whether an image has been tampered with or has been modified [4]. The watermark is distorted if the image is manipulated in the slightest manner. The Fragile watermarks are capable of localization, and are applied to determine where manipulations were made to an image. The Traditional methods embed checksums or pseudo-random sequences in the Least Significant Bit (LSB) plane [5].

The Semi-fragile watermarks combines the properties of both fragile and robust watermarks [4]. Like the robust methods, they can tolerate some degree of manipulation to the watermarked image (for example, quantization noise from the lossy compression). Like fragile methods, they are able of localizing regions of an image that are authentic and those that have been changed.

Recently, much emphasis has been made on semi fragile medical image watermarking. Jagadish *et al.* founded the interleaving hidden information in the Discrete Cosine Transform (DCT) and the Discrete Wavelet Transform (DWT) domains [6]. The DCT and DWT domains are widely studied because they are related to the JPEG and JPEG2000 compression techniques respectively.

Discrete wavelet transformation: This method divides the cover image into four sub bands where higher band shows finer details and lower band has more important message or information. A Entropy coders locate the transform coefficients and also encode them. A DWT technique has extra edge (sharp) over DCT that it allows efficient energy compaction than DCT without any artifacts blocking after the process of coding. A DWT has a multi-resolution nature that makes it more fit for the scalable image coding. There are the several other types of transforms that can be used with DWT such as Curvelets transform, integer transform, contourlet transform, dual tree DWT etc.

Discrete Cosine Transformation Technique: The Discrete cosine transformation is very popular steganography techniques which is mostly suited for JPEG images. The JPEG images are mostly used over the internet and have the lossy compression. The DCT is widely used for the image and video compression. Every block of the DCT is quantized by the help of quantization table of the JPEG. The Quantized coefficients are used to embed the secret or hidden message.

III. MEDICAL IMAGE WATERMARKING

There has been lot of work done in the field of medical image processing. Before proceeding with the survey of medical image processing, it covers the foundation of the digital watermarking, types of domain and the performance measurement. The typical block diagram for the medical image watermarking is shown in figure 1. The Encoder E embeds the watermark W in the medical image to provide the security & authentication.

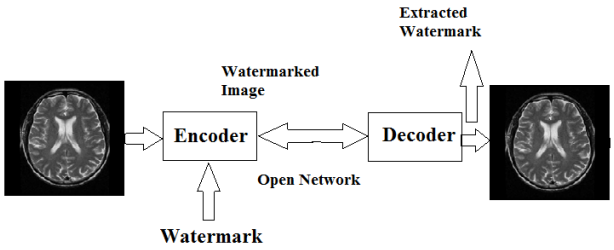


Fig.1. Block Diagram of Medical Image Watermarking

The Decoder D decodes the watermark from the watermarked image. By comparing the extracted watermark with original watermark, one can confirm the tampering of medical image. According to the watermark embedding method, watermarking techniques are divided into two different domains.

(i) Spatial domain: The spatial-domain watermark insertion manipulates the image pixels. However, the spatial-domain watermark addition is very simple and easy to implement, it is weak against various attacks and noise.

(ii) Transform domain: The transform-domain watermark insertion depends on the transform coefficients of the cover image. It is highly robust against attacks. The Discrete Wavelet Transform (DWT), Discrete Cosine Transform (DCT), and Discrete Fourier Transform (DFT) are three widely used methods in the transform domain.

Every watermarking system has few very important desirable properties. Some of these properties are also conflicting and we are pressured to accept some trade-offs between these properties based on the application of the watermarking system. The first and also the most important property is effectiveness. This is the probability that the data in a watermarked image will be exactly detected. We ideally need this probability to be 1.

Another necessary property is the image fidelity. The Watermarking is a process that changes an original image to add information to it, therefore it inevitably affects the quality of the images. We want to keep this decomposition of the image's quality to a minimum, so no obvious changes in the image's fidelity can be examined. The third property is the payload size. Every watermarked work is used to carry a message or information. The size of this information or message is important as many systems require a relatively big payload to be embedded in a cover work. The false positive rate is also very important for watermarking systems. This is the number of digital works that are examined to have a watermark embedded when in fact they have no embed watermark. This should be kept very low for the watermarking systems.

Lastly, robustness is crucial for maximum watermarking systems. There are many such cases in which a watermarked work is changed during its lifetime, either by transmitting over a lossy channel or various malicious attacks that try to delete the watermark or make it undetectable.

IV. SYSTEM IMPLEMENTATION

The system architecture is shown in figure 2 and consists of largely three main parts- Patient Information generation, Embedding and extraction described in detail as below:

1. Patient information generation:

The first step is to generate the patient information in a suitable format so that it can be easily embedded in the image. The various details which are present in this information are:

- Patient ID : PID
- Date of Birth : DOB
- Blood Group : BG
- Diagnosis Report : DR

The above information has been generated for this particular research work in the form of a bit mapped image using Microsoft Paint.

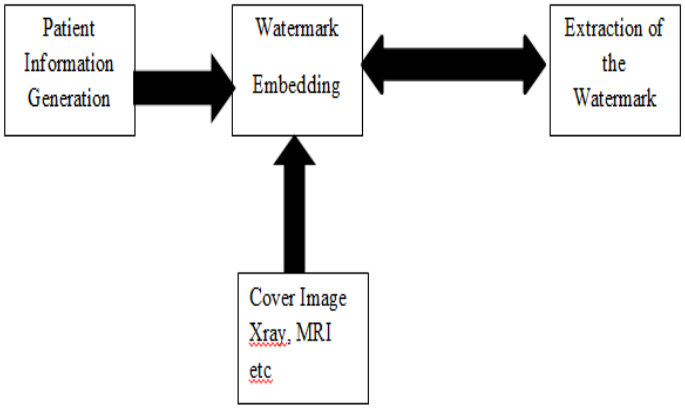


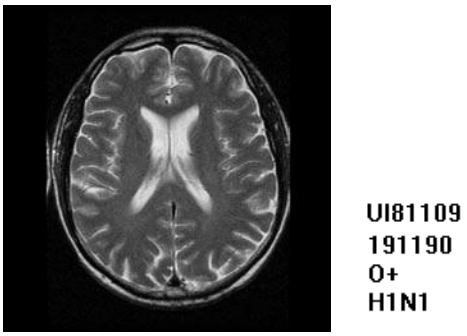
Fig 2: Architecture

2. Embedding Process:

The embedding process consists of embedding the above obtained patient information in the cover image. The cover image also called as original image is the medical image resulting from medical scan of the patient. For this research, various scan images available on the internet have been used. The result of the embedding process is the watermarked image which contains the hidden message behind the original cover image. This image can now be sent over the network.

3. Extraction Process:

The extraction process is implemented at the receiver side to find out the hidden watermarked image containing the patient information. If the hidden image is obtained either partially or fully it validates the authenticity of the image and at the same time gives valuable information about the patient's medical diagnosis at the sender end.



(a) (b)

Fig 3: (a) Brain.png (b) Watermark

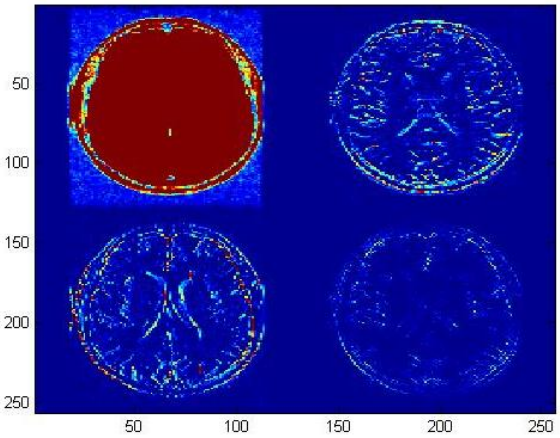


Fig 4: DWT Decomposition

Fig 5: Extracted Watermark

The above figures show the results for brain1.png image, shown in Figure 3(a). Figure 3(b) shows the Watermark image to be embedded inside the original image acting as cover image. Figure 4, shows the Wavelet Decomposition result of the cover image. The DWT as explained earlier divides the image into a number of frequency sub-bands. As evident from the figure, the last two sub-bands contain least significant frequency components, and thus ideal for hiding the watermark image and it will cause very minimal to no change on the image when reconstructed. The extracted Watermark is shown in Figure 5.

V. CONCLUSION

There exist different type of medical image watermarking algorithms which gives the confidentiality of medical data, recovering the original image without any loss, data integrity, authentication and efficient data management. The primary aim of this research work was to study the different data hiding techniques and to perform an algorithm for watermarking the medical data of patients in medical images like MRI scan, X-Ray scan and other kinds of medical images. The motive was successfully achieved in the proceedings of this research work. The future research work can be progressed towards applying this algorithm for images of bigger sizes such that of DICOM images. Another attempt can be made to involve more relevant information. For the scope limitation of this research work, the tests have been performing on the same computer. Thus actual variation in the quality of the watermarked image after transcribing at a far off place is yet to be seen. This can be a further exciting field for the research.

VI. REFERENCES

[1] Giakoumaki, Sotiris Pavlopoulos, and Dimitris Koutsouris, (Oct. 2006) "Multiple Image Watermarking Applied to Health Information Management", IEEE Trans. on information technology in biomedicine, vol. 10, no. 4

[2] J. Fridrich, M. Goljan, and R. Du. Invertible authentication. In *Proc. SPIE, Security and Watermarking of Multimedia Contents III*, volume 3971, pages 197–208, San Jose, USA, Jan. 2001.

[3] I. Ueno and F. Ono. "Prouosed modification of LOCO-I for its improvement of the performance." ISOIIEC JTCl/SC29/WGl doc. N297. Feb. 1996.

[4] E. T. Lin, C. I. Podilchuk, and E. J. Delp. Detection of image alterations using semi-fragile watermarks. In *Proc. Of the SPIE Int. Conf. on Security and Watermarking of Multimedia Contents II*, volume 3971, pages 152–163, San Jose, CA, USA, Jan. 2000.

[5] N. F. Johnson, Z. Duric, and S. Jajodia. *Information Hiding: Steganograph and Watermarking - Attacks and Countermeasures*. Kluwer Academic Press, Dordrecht, the Netherlands, 2001.

[6] N. Jagadish, P. S. Bhat, R. Acharya, and U. C. Niranjan. Simultaneous storage of medical images in the spatial and frequency domain: a comparative study. Biomedical Engineering Online, 3(1):record 17, June 2004.

[7] M. J. Weinberger, G. Seroussi, G. Sapiro, and E. Ordentlich, "JPEG-LS with limited-length code words." ISO/IEC JTCl/SC29/WGl doc. N538, July 1997.

[8] S.Arivazhagan1, W.Sylvia Lilly Jebarani, G.Kumaran, Performance Comparison of Discrete Wavelet Transform and Dual Tree Discrete Wavelet Transform for Automatic Airborne Target Detection, International Conference on Computational Intelligence and Multimedia Applications 2007, pp 495-500.

[9]. M. J. Weinberger, G. Seroussi, and G. Sapiro, "LOCO-I: A low complexity, context-based, lossless image compression algorithm," in Proc. DCC'SG, (Snowbird, Utah, USA), pp. 140-149, Mar. 1996.

[10]. Chun-Hsiang Huang, Chih-Hao Shen & Ja-Ling Wu," Fidelity-Controlled Robustness Enhancement of Blind Watermarking Schemes Using Evolutionary Computational Techniques", Volume 3304 of the series Lecture Notes in Computer Science pp 271-282.

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