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Multi Watermarking for Medical Images using Fractal Encoding and Concept of UNET

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Abstract: ***The Internet of Medical Things, smart healthcare systems are becoming ubiquitous in our daily lives. Patients, doctors, and other medical personnel rely on the safe and efficient storage, transmission, and analysis of electronic health records , medical images such as scanning reports X-rays for successful treatment and management of different ailments. A Multi watermarking method is proposed for medical images based on quantum random walk and optimization algorithm. A logo image is used to verifying medical image integrity is embedding in region of interest and text data are embedded in the region of non interest to conceal private hospital and patient informations. This method improves the authenticity and integrity of medical images. A number of experiments are conducted to validate the security ,robustness and capacity of the proposed multi watermarking scheme.***

Keywords: medical image, quantum random walk, optimization algorithm, Internet of Medical Things

I. INTRODUCTION

Internet of Medical Things (IoMT) refers to medical devices and applications with internet connectivity. it's a subset of internet things and for this reason is often refers to as IoT in healthcare. IoMT devices connect patients, doctors and medical devices including hospital equipment, diagnostic gear, and wearable technology by transmitting infromation over a secure network. Medical images are increasingly transmitted over public networks, driven by the demand for telemedicine. However, these networks are known to be insecure, potentially facilitating the tampering, destruction, or theft of medical images without authorization. This can lead to serious economic losses, misdiagnosis, and poor treatment outcomes.

Digital watermarking technology has shown promise in recent years, having been extensively used in copyright protection of digital images concealment of electronic patient records verification of region of interest (ROI) integrity in medical images, and source authentication Notably there is a higher demand for medical images with verified integrity and authenticity for transmission which makes the pursuit of imperceptibility, robustness, capacity, and security increasingly challenging yet critical. Watermarks embedded in digital images can either be visible or non-visible [1].

Invisible watermarks can be divided into three categories: fragile, semifragile, and robust watermarking. Fragile watermarking has little effect on the visual quality of a host image but is susceptible to attacks, making it suitable for integrity verification. Robust watermarking is resistant to different types of attacks and is often used in image copyright protection and data hiding. Semi-fragile watermarking can protect against filtering and slight noising but is vulnerable to malicious attacks such as cropping and rotation. Additionally multi watermarking usually refers to the simultaneous embedding of two or more watermarks (e.g., logo and text) into the spatial and/or frequency domain of the cover image. It has received increasing attention because it offers simultaneous applications for copyright validation, data concealment, and integrity detection. Given these benefits, multi-watermarking must balance the invisibility and robustness of watermarked images.

The objective of the work is to protect the copyright of digital multimedia on the internet. Patient's private information may be leaked or subject to malicious attacks. The use of medical image watermarking technology can effectively solve this problem. Digital watermarks may be used to verify the authenticity or integrity of the carrier signal or to show the identity of its owners.

The rest of the paper is organized as follows , Section II discusses the related works on multi watermarking for medical images and Section III describes the conclusion.

II. LITERATURE REVIEW

Digital medical images contain important information regarding patient's health and very useful for diagnosis. Even a small changes in medical image can mislead the doctors for deciding further treatment. The protection of the image against intentional or unintentional tampering, forgery, filtering, compression and other common signal processing attacks are mandatory. This manuscripts presents a multipurpose medical image watermarking scheme to offer copyright or ownership protection.

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Watermarks embedded in digital images can either be visible or non-visible The methods used to produce invisible watermarks can be divided into three categories fragile, semifragile and robust watermarking [2]. Fragile watermarking has little effect on the visual quality of a host image but is susceptible to attacks making it suitable for integrity verification. Robust watermarking is resistant to different types of attacks and is often used in image copyright protection and data hiding. Semifragile watermarking can protect against filtering and slight noising but is vulnerable to malicious attacks such as cropping and rotation. Additionally, multi watermarking usually refers to the simultaneous embedding of two or more watermarks (logo and text) into the spatial and or frequency domain of the cover image. It has received increasing attention because it offers simultaneous applications for copyright validation, data concealment, and integrity detection.

Given these benefits multi-watermarking must balance the invisibility and robustness of watermarked images. Watermarking has previously been applied to medical images [3]. Rahman et al. proposed a reversible and fragile watermarking scheme to achieve a high level of secrecy and maintain the integrity of images [4]. This approach is advantageous as it can offer high imperceptibility after embedding the watermark. However it is also susceptible to attacks. Nazari et al. developed a robust and secure chaos-based watermarking scheme utilizing an integer wavelet transform (IWT) and least significant bit (LSB). This approach not only verified ROI integrity but also effectively hide private data to guarantee secure transmission of authenticated medical images [5].

1) An algorithm is developed to automatically resize the logo image to match the size of the ROI such that every ROI pixel is embedded with logo information. This approach improves ROI integrity verification.
2) Quantum Random Walk (QRW) is used for the first time to generate pseudo-random numbers for encryption of the logo image. Embedding the encrypted logo into the ROI enhances both the security and sensitivity of the image.
3) A compression algorithm is introduced to increase the capacity of text data embedded in RONIs. This not only effectively reduces the size of text data but also facilitates encryption of the compressed data.
4) The Brain Strom Optimization (BSO) algorithm is applied for the first time to optimizing a scaling factor used for embedded text in RONIs providing a trade-off between the imperceptibility and robustness of each watermarked RONI.

Secret image sharing (SIS) scheme is an important technology to protect secret information. It distributes the secret data into multiple shares so that the participants can obtain the embedded secret by sharing their authenticated shares. Through a simple process of these shares the secret data can be extracted. A SIS scheme based on a fractal matrix. Through guidance of the proposed fractal matrix the secret data can be distributed into three shares which are indistinguishable from their corresponding cover images. Any two of the three distinct shares can cooperate to extract the exact secret data. The data hider uses three distinct cover images to embed secret image or data and generates three shares which are visually indistinguishable from their corresponding cover images. The three shares are then distributed to three participants. To recover the secret data any two of the participants who combine their shares can completely decrypt the secret.

We provide an authentication mechanism to detect tampered shares and prevent from cheating events to be used before the decryption. When all three shares can be obtained an even stricter authentication mechanism is available. Moreover we devise two authentication mechanisms to prevent from tampering. The authentications are also effective and easy to implement.

Fractal is a special type of reference matrix which is applied to guide the production of shares in their secret sharing scheme. A fractal matrix is constituted by a lot of fundamental three- dimensional structures called fractal models. The elements in a fractal model are so ingeniously arranged that the projections of all elements in a fractal group onto each axial plane constitute a perfect square matrix.

A novel robust approach for image copyright protection based on concentric rectangle presents an adaptive method. The image is transformed into a wavelet domain using a multi- level of lifting wavelet transform. Various notable watermarking techniques are developed by potential researchers.

The main objective of medical image authentication techniques are protecting the medical images from tampering and verifying there integrity. A survey Multimedia Tools and Applications With the widespread growth of medical images and improved communication and computer technologies in recent years authenticity of the images has been a serious issue for E-health applications. In order to this various notable watermarking techniques are developed by potential researchers. However those techniques are unable to solve many issues that are necessary to be measured in future investigations.

The various scope of Watermarking such as “privacy preserving medical record searching schemes and dual watermarking framework for industrial image authentication and tampering”. The blind dual water marking for color image authentication and protection. Security of health record is important aspect for patient privacy. And an adaptive and robust method for image copyright protection to control ownership and prevent unauthorized usage of image property.

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We proposed an effective compression algorithm to enhance text data security and increase RONI capacity. In addition , our algorithm can effectively extracting text data from watermarked images for authenticating the image. The Internet of Medical Things smart healthcare systems are becoming ubiquitous in our daily lives. Patients, doctors, and other medical personnel rely on the safe and efficient storage, transmission, and analysis of electronic health records, particularly medical images, for successful diagnosis, treatment, and management of different ailments. In this study, a multi-watermarking scheme is proposed for medical images based on quantum random walk and the brain storm optimization algorithm. A logo image used to verify medical image integrity is embedded in regions of interest, and text data are embedded in regions of non-interest to conceal private hospital and patient information. This process improves the accuracy of medical image verification and helps to ensure authenticity. A series of experiments were conducted to validate the capacity, security, robustness, and imperceptibility of the proposed multi- watermarking scheme.

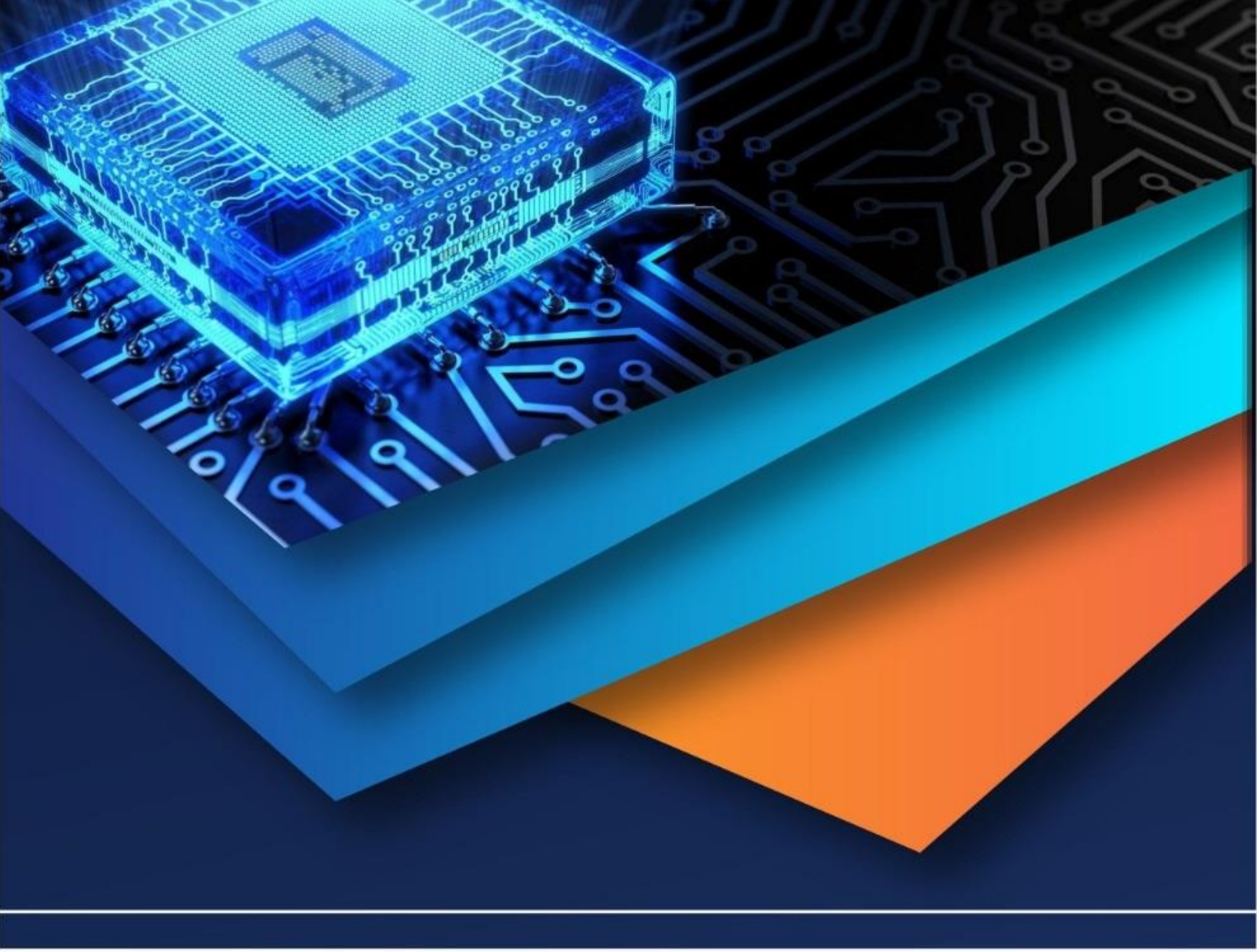
The logo image is embedded into host image. Then finding region of interest and logo image is resize with respect to ROI. Then converting to binary sequence and perform encryption then embedding the logo image into host image finally watermarked image is obtained. Here text data is embedded into host image. Automatically resizing the image and inserting text data. Then it decomposed and perform encoding. Finally hidden data is find out. The text data is compressed and inserting into host image. The text data such as patient name, age, previous health records etc.

III. CONCLUSION

A multi watermarking scheme for medical image security was proposed and demonstrated. Images were segmented by selecting ROIs to obtain ROI and RONI images. A logo image and text data (private information concerning patients, doctors, and hospitals) were embedded in the ROI and RONI respectively to verify ROI integrity and authenticate the image. In addition an algorithm was designed to automatically adjust the size of the logo to provide further validation. QRW on a circle was used for the first time to encrypt the logo image there by increasing its security and sensitivity. We also proposed an effective compression algorithm to enhance text data security and increase RONI capacity. The BSO algorithm was used for the first time to determine an optimal scaling factor for the trade-off between invisibility and robustness in watermarked RONIs images. Experimental results showed this approach offers very high invisibility and can accurately determine images have been damaged or tampered with. In addition our algorithm can effectively extract text data from the watermarked RONIs for use in authenticating the image.

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