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Electronic Patient Record Maintenance Scheme Based on Tidemark- Wavelet Packet Transform

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Abstract:

The main purpose of this paper is to preserve the patient's medical images and electronic records in the healthcare center for enabling the distribution of patient data and exchange between networked hospitals and healthcare centers. The healthcare center and hospitals have to provide assurance of security, legitimacy, and supervision of medical images and information over storage and distribution. The watermarking techniques are rising to provide security for medical healthcare information. The medical data and electronic patient's record can be encrypted in the secret format, then the embedded EPR information and medical images are to be saved in storage space and transmission overheads and provide assurance security of the shared information. The discrete wavelet packet transform (DWPT) method is a novel approach to shielding the patient statistics of the medical image by means of the hospital logo as an allusion image. Several error correction and detection techniques are used to provide greater security to medical information, mainly concentrated on forward error correction code (FEC) and BCH code, to improve the robustness of the proposed method.

Indexed Items: - *forward error correction code (FEC), BCH code, medical images, electronic records.*

I. INTRODUCTION

An electronic health record (EHR), or electronic medical record (EMR), is a digital recording format structure used to gather patient and people health statistics are electronically put in storage in digital form. These archives can be shared with different health care centers. This can be done by network-connected systems, an initiative with wide information schemes, or other information networks and exchanges. EHRs may contain a variety of data, together with demographics, medicinal history, tablet and allergies, vaccination status, test site test results, radiology pictures, dynamic signs, personal information like age and weight, and billing information.

EHS schemes are intended to store data correctly and to gather the patient status crosswise time. It removes the need to pathway a patient's earlier paper medical records, and contributions in guaranteeing data are accurate and intelligible. It can diminish the risk of data repetition as there is only one adaptable file, which worth the file is additional likely up to date and declines the risk of lost book-keeping. Owing to the digital data being searchable and in a solitary file, EMR's are more operative when take-out medical data for the investigation of conceivable trends and long term variations in a patient. Population-based lessons of medical archives may also be simplified by the widespread adoption of EHR's and EMR's.

The communication, storage, and distribution of electronic therapeutic data using the systems have many commitments like analysis report and discover new drugs, scientific investigation. Clinics and medical centers have enormous databanks together with medical images, text, and patient records. The conversation of these databases concluded the networks have a need for content administration to index medical record facts and a high degree of security and authenticity to preserve the privacy of the patients' information. To achieve these objectives, different techniques of digital watermarking have been employed. In paper [2] projected a technique for watermarking medicinal images with express in code patient data in the longitudinal domain by the trade-off of the lower significant bits of the grey standards of selected pixels of the medicinal image with that of the Tidemark. In [3], the encoded patient information, which is coded with error correction codes, is transacted with the least significant bit (LSB) of the greyscale image. Nambakhsh*et al.* [4] offered a watermarking method joint with the entrenched zero-tree wavelet algorithm (EZW). A hash function is functional to 7 bit plane of image and XOR with the oblique diagnosis put in by the doctor. The subsequent message is introduced in the LSB plane. Huang *et al.* applied a set of rules which customs a portion of patient' records in EXIF metadata as a Tidemark. The 7x7 block discrete cosine transform (DCT) is achieved on the medical image, and the central frequency factors of each lump are selected to embed Tidemark bits. Most of the preceding research in works has engrossed on preserving the determination of the medical images after entrenching the watermark irrespective of testing the robustness of the arrangements against different attacks.

II. Conventional method

The 2D- discrete wavelet packet transform is a sweeping statement of 2D- wavelet conversion. This is a more elastic tool proposing richer image persistence. In the orthogonal wavelet disintegration procedure, the generic rule splits only the estimate coefficients sub-band of the spitting image into four sub-bands. After this split, we attain a sub-band of estimate coefficients (L.L.) and three sub-bands of detail coefficients. The next rule consists of splitting the new approximation coefficient sub-band in a recursive method were the consecutive details sub-bands are not ever reanalyzed. In the consistent wavelet pack situation, each detail constants sub-band is also disintegrated into four sub-bands using the same method as in estimated subband splitting. The DWPT for two levels is the wavelet packet convert for an image gives a vast sum of sub-bands of wavelet coefficients at dissimilar resolutions. This allows more flexibility to select a sub-band or more to embed watermark, and this will increase the watermarking security.

The Digital Imaging and Communications in Medicine (DICOM) standard is the method for the altercation of medical data. The DICOM medical image files are devoted to header comprising patient data, which may be lost, criticized, or tangled with other header files. Though, the watermarking of medical images using patient information overwhelms these problems. However, there is an encounter that interweaving data in a medical image must not disturb the image quality as this may result in the wrong diagnosis.

III. PROPOSED METHOD

The proposed method is based on tidemark embedding procedures based on the DWPT. The patient information can be put in the electronic patient record (EPR), which consist of private information (name, age, height, and weight, etc.), hospital information like name, doctor name, etc., diagnosis and some administration information (record number, date, ... etc.). And the list of tests, scan reports, diagnosis details. The model electronic patient's record shows in fig. 1. All the data is transformed from the ASCII code to binary code. Afterwards, the BCH error-correcting code is used to encode the binary string. The resultant bitstream is the entrenched watermark, and using ECC enhances the robustness of the watermark.

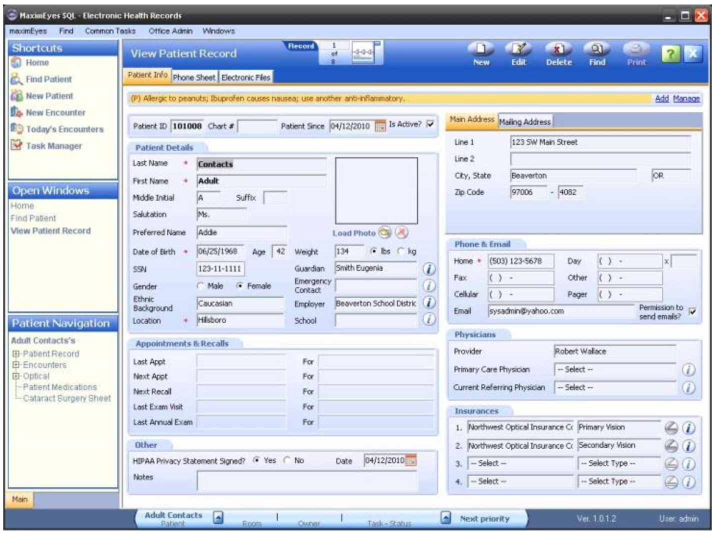

Fig. 1 Electronic Patient's Record form

Tidemark Embedding Method

There are a number of rules that are followed in Tidemark embedding, as shown in fig. 2

Rule1

First, apply the MxNmedical image Into m-levelDWPT, which generates4m sub-bands of wavelet coefficients.

Every sub-band coefficients are assigned as a matrix form at an exact resolution with size men where n= N/4m/2.

Rule 2

Then find the energy values for each sub-band by using the energy equation:

$$E = \frac{1}{nxn}\sum_{i=1}^{n}\sum_{j=1}^{n} C^2(i,j) \quad (1)$$

In the above equation, *E* signifies the energy, nxn denotes the size of the sub-band, and *C* is the coefficient of DWPT. To confirm the trade-off among robustness and inaudibility, there are two sub-bands B1 and B2with middle energy are nominated for Tidemark embedding. The B1 and B2sub bands are again divided into 4x4blocks be, where *r* is the sub-band sum of *1* or *2* and *k =1, ..., n/4* is the block number.

Rule 3

Then the next step is to make a grayscale reference image *R* whose size is equal to *mxn*. The process followed again the reference image is also separated into blocks *Rk*of *4x4* pixels where *k=1,...,n/4*. This reference image is used for blind embedding.

Rule 4

One bit of the Tidemark is entrenched per block. By considering the worth of the bit, the block of the reference image ***Rk***isadditional to the consistent sub-band block *br,k* conferring to the following rule:

$$b'_{r,k} = \begin{cases} b_{r,k} + \alpha R_k & if\ w = 0 \\ b_{r,k} - \alpha R_k & if\ w = 1 \end{cases}$$

Whereα is the strength and *w*is the Tidemark bit. The number of blocks of *B1* plus *B2* equals the number of embedded Tidemark bits.

Rule *5*

The progression*Rule 4* is repetitive up to the size of the Tidemarkbitstream.

Rule 6

Then inverse discrete wavelet packet transform was performed to obtain the modified wavelet coefficients toTidemarkbitstream.

The extraction phase of patient information from the watermarked medical image is unsighted, so no need to recover the original medical image from extracting patient information. For each block, calculate the correlation coefficient value amongst the reference image block and the consistent block of watermarked sub-bands

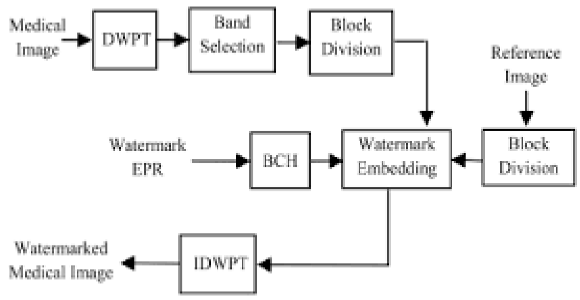

Fig.2 Tidemark embedding rules

IV. Results

The proposed techniques have been evaluated using the Tidemark testing algorithm the greyscale images shown in fig.3 the radiological image size512* 512 pixels have been used. By relating two levelsDWPT, the size of both sub-bands is 128x128 pixels. Two sub-bands are preferred to implantTidemark and are divided into 4x4 blocks, so the total amount of blocks are2*(128/4*128/4) = 2068 blocks. The size of the patient material place into EPR is148 characters, which has been transformed into a binary matrix of 7x136 (each attractiveness signified by 7 bits). By means of BCH code, the binary matrix converts 15x136. The binary matrix has been transformed into a vector of 2068 bits. The bitstream is padded by zeros to turn into of length 2048. However, each Tidemark bit is embedded into one block. The reference image is preferred as a hospital logo of size128x128. When color and monochrome images are shown together on conformist monitors, both pictures are exposed with the same brightness and grayscale tones.

Fig.3 Radiology-greyscale image

The Tidemark can be improved with no BER for value 3 while for value 0.5, both C.T. and Radio pictures are recovered with 7.5% and 0.2% individually. On the next side, the patient data is properly recovered without any error in the instance of contrast attack by factor 10. But, when this feature is amplified to 30, the patient information unsuccessful in being taken out from the image starved of error except for the case of the MRI1and Radio2 images.

V. Conclusion

The proposed method has been introduced a blind watermarking scheme which used to develop embed patient information in a secluded and secure manner. The projected scheme fulfills the security of medical patient data and permits sharing the medical data in the least and manageable without extra cost or storage space and lacking any consequence on medical image quality. We observed the security of the structure by spread over some attacks and determining the robustness of the structure by BER and N.C. and investigative the visual eminence of the medical image by PSNR. Investigational results show that the proposed system is vigorous against common attacks such as Gaussian noise, gamma rectification, in voluntary equalization, contrast adjustment, revolution, and sharpening, median filter, and JPEGcompression with dissimilar Q.F. Also, it has been experiential that the Radiological image is the greatest robust type of medical image in contrast to attacks.

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