Security in Telemedicine: Watermarking medical images

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Modern health care infrastructure is based on digital information management. The digital imaging and communication in medicine (DICOM) standard facilitates the communication of digital image information regardless of device manufacturer. It is usual that a medical image is diagnosed before storing the image in the long-term storage, so the significant part of the image is already determined [1]. The significant part is called ROI (Region of Interest). Although the recent advancement in information and communication technologies provide new means to access, handle and move medical images, they also allow easy manipulation and replication [2]. It is common view that there is an urgent need of security measures in medical information system.

Digital watermarking can imperceptibly embeds messages without changing image size or format. When applied for medical images, the watermarked image can still conform to the DICOM format [3]. Some researchers already apply watermarking technique for medical data. Zhou et al present a watermarking method for verifying authenticity and integrity of digital mammography image [4]. They used digital envelope as watermark and the least significant bits (LSB) of one random pixel of the mammogram is replaced by one bit of the digital envelope bit stream. Instead of the whole image data, only partial image data, i.e. the most significant bits (MSB) of each pixel is used for verifying integrity. Other researchers adapt digital watermarking for interleaving patient information with medical images to reduce storage and transmission overheads [5]. Again, the LSB of image pixels are replaced for embedding. Chao et al propose a discrete cosine transform (DCT) based data-hiding technique that is capable of hiding those EPR related data into a marked image [6].

The information is embedded in the quantized DCT coefficients. The drawback of the above watermarking approaches is that the original medical image is distorted in a non-invertible manner. Therefore it is impossible for watermark decoder to recover the original image. A reversible watermarking scheme involves inserting a watermark into the original image in an invertible manner in that when the watermark was later extracted, the original image can be recovered completely [7-10]. Research has also been done in the area of reversible watermarking in medical images. Trichili et al proposes an image virtual border as the watermarking area [11]. Patient data is then embedded in the LSBs of the border. Guo and Zhuang present a scheme where the digital signature of the whole image and patient information is embedded [3]. Cao et al extend their work on digital envelope and embed their DE by making a random walk sequence and replace LSB of each selected pixel [12].

The research objectives are:

1. To investigate the possibility to develop a reversible watermarking technique and if positive to develop such a technique
2. To take the developed technique and apply and investigate over specific medical application
3. To comment on preliminary clinical evaluation of the system.

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