Chapter 12
Biomedical Watermarking:
An Emerging and Secure Tool for Data Security and Better Tele-Diagnosis in Modern Health Care System

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ABSTRACT

The proposed chapter describes the need of data security and content protection in the modern health care system. A digital watermarking technique is used as a strong and secure tool to achieve ultimate security. In this chapter the authors discuss some existing watermarking techniques and also describe some new types of data hiding techniques using biomedical watermarking techniques in both spatial and frequency domain which would help keep the authenticity and secure the contents of the hidden biomedical information for accurate tele-diagnosis. These techniques use multiple copies of the same information that is to be hidden in the cover image. The bandwidth requirement is greater, but reconstruction of hidden information is more accurate at the time of recovery even under several unintentional attacks. Some new types of embedding and recovery processes have also been employed for better results and success of the different proposed schemes. The Modified Bit Replacement (MBR) embedding process and the Bit Majority Algorithm (BMA) technique for recovery of the hidden information are the newer approaches that are also described here.

INTRODUCTION

Recent innovations and advancements in Medical Science not only increase the quality of the treatment, it also has introduced some new concepts like tele-diagnosis, tele-medicine and tele-surgery. These new concepts in modern health care system can give the facility of remote patient monitoring and helps patients to have a better diagnosis and treatment without actually going to the treatment center. A number of expert doctors from different locations can give their views and suggestions in the form of Electronic Patient Record (EPR) (Pal et al., 2012). The digitization of patient information such as EPR (electronic patient records), clinical and diagnostic images offers significant flexibility in medical diagnosis. In modern health care systems, HIS (Hospital Information System) and PACS (Picture Archiving and Communications System) (Cao et al., 2003), has formed the latest information technology infrastructure for a hospital based on the DICOM (Digital Imaging and COmmunication in Medicine) standard. And even this EPR can be stored for any future correspondence or reference.

As per the existing regulations prescribed by DICOM (Kobayashi et al., 2009), all patient records need to be secured and information confidentiality maintained. For biomedical images, modifications should not occur during data transfer over networks for both legal reasons and accurate treatment. If medical data is illegally obtained and the content is changed, it may lead to wrong diagnosis. Therefore, different protection mechanisms have evolved through several encryption and authentication techniques. Digital watermarking is one of the safest and popular methods that can embed medical data in a cover image without violating the DICOM format and enhancing medical data security. However, medical image watermarking requires extreme care when embedding additional information within medical images, because the additional information should not degrade the medical image quality (Liew et al., 2010).

Therefore appropriate biomedical image watermarking technique can introduce a new security layer that we expect to be preserved by continuous protection of the information during data storage, transmission.

Biomedical image watermarking is the process of embedding information imperceptibly into a medical image without changing image size or format such that the hidden information or the watermark can be extracted or recovered later. When applied for medical images, the watermarked image can still conform to the DICOM format. Some of the necessity for applying watermarking techniques to medical images is mentioned (Huang et al., 2011).

1. Watermarking technique should be invertible or reversible means once the image has been verified, the watermarked image should be reverted to the original image by removing the watermark.
2. There should be minimal perceptible changes in the watermarked image. The watermarked image should visually be the same as the original image.
3. There should be no impact on the stored images in the PACS server due to introduction of watermark.
4. Modification of the watermarked image may lead to unsuccessful verification. So proposed watermarking schemes should not change the amount of data that needs to be transferred.
5. Watermarking technique for authentication should be applied while transferring image data in DICOM format over the network.

A watermarking method is usually designed depending on a compromise between different requirements: capacity robustness privacy and imperceptibility. A biomedical image watermarking technique can be characterized by the following four features: imperceptibility, robustness, security, and capacity (Zain et al., 2007).

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