

## Chapter 3

# Data Hiding in Digitized Medical Images: From Concepts to Applications

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### **ABSTRACT**

*This chapter envelops data hiding techniques applied to medical images for improving their security. It covers types of medical images, their security requirements and types of threats to them. This provides a sufficient background and reasoning for applying data hiding techniques to the medical images. The purpose of this chapter is to study requirements of data hiding techniques with respect to medical imaging and to cover state of art methods in this domain. These techniques are developed from different application perspectives helping to understand their limitations and strengths. The chapter culminates with study of algorithms for reversible watermarking techniques and discussion on future of watermarking in medical domain.*

### **INTRODUCTION**

Growth of digital technologies and communication networks has empowered the storage, transmission and retrieval of records from electronic database. This can have a wide spread applications in health sciences. ICT medical applications range from

tele-medicine, tele-surgery, cooperative working, tele-diagnosis, to robotic surgery. Telemedicine or tele-diagnosis applications require transmission of medical images over a relatively insecure public domain computer networks. The demand will be similar to any public domain packet switched network like loss, retransmissions, compression and security issues. Transmission of data is also possible over more secure and private hospital

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networks. These kinds of networks may not have issues in terms of loss, retransmission, compression but malicious attempt to break into network for unauthorized access is a real threat. Thus there is a grave danger to shared Electronic Patient Record (EPR) in such situations and there is a need for security in both “online” and “offline” world. EPR is highly private in nature and its disclosure can cause severe personal, economic, social and political issues. EPR is converted into different types of file formats where it would be authorized and used by the medical practitioners. The involvement of physicians in authorization and format conversion process can be highly cumbersome for them. Thus one has to look for the techniques which are less demanding to physicians and at the same time provide adequate security to EPR. This chapter aims at providing the adequate security to the medical images through application of data hiding techniques.

### **Medical Imaging, Their Types and DICOM Format**

Medical practitioners are dependent on images for diagnostics. Medical images cover a very wide spectrum within medical domain. Images capture morphology of internal parts and to an extent their functionality. Doctor concludes about proper functionality of the internal organs and lookout for pathological issues within them. Medical imaging uses conventional X ray techniques to images generated by computational techniques like Computer Tomography (CT). There are varieties of techniques belonging to computational category like Nuclear Magnetic Resonance (NMR), Positron Emission Tomography (PET) (Ryszard Tadeusiewicz, 2004). Many techniques use injection of reactive agent within body to obtain image. Ultra sonography (USG) is one such technique which uses absorption and reflection of ultra sound waves to generate images of internal body organs. Autoradiography visualization techniques utilize ionizing gamma radiation emitted by radioactive

organs. The radioactive material has to be inserted into patient body. Thermo vision images are also used to capture organization and functioning of internal parts of human body. All these medical imaging techniques provide immense knowledge to the medical practitioners and help them to conclusive diagnosis, and recovery plans from disease. Practitioner are increasingly referring to medical images when faced with a complicated problem. However medical images for individual are highly random and would further compound the problem for practitioners. A doctor looking at an medical images tries to understand the following issues:

1. How internal organs are appearing?
2. Why they are appearing in this specific manner?
3. What biological reasons can cause this shape, shade, brightening or change in texture?

One has to also concur with the fact that with increasing dependence on technology doctors have to quickly learn and unlearn new technology. This sometimes can be a cause for false diagnostics. Different modalities images have distinct requirements for storage and transmission. Thus there is a need for standard to ensure interoperability.

### **DICOM Formats**

Digital Imaging and Communications in Medicine (DICOM) (DICOM Standard, 1993) is the standard created by American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) in 1993. The standard is created for transmission of medical images with metadata, storing, printing, and handling of medical image data. There are number of other bodies like ANSI, IEEE with whom liaison is done for development of this standard. DICOM standard defines the DICOM object format and communication protocol. Thus it solves the interoperability issues in the medical domain. DICOM object

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