Chapter 2
The Fundamentals of Biomedical Image Processing

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ABSTRACT

This chapter provides a brief introduction to the various fundamentals and concepts related to the basics of the biomedical image processing. Medical imaging processing comprises various techniques and processes that are used to create images of human body for clinical purposes and medical procedures for the purpose of diagnosis or examination of disease. Digital image processing along with its suitable components and computer-simulated algorithms are implemented using computers to perform the image analysis of digital images. The study of normal anatomy and physiology of human body is made as a part of diagnosis process. Though medical imaging of various organs and tissues can be performed for medical examination purposes, the impact of digital images on modern society is tremendous and image processing has become a critical component of science and technology related to the biomedical image processing.

INTRODUCTION

As the expanding utilization of direct sophisticated imaging frameworks for therapeutic diagnostics, computerized picture handling turns out to be increasingly essential in social insurance. Notwithstanding initially computerized techniques, for example, Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), at first simple imaging modalities, for example, endoscopy or radiography are these days outfitted with advanced sensors. Computerized pictures are made out of individual pixels (this acronym is shaped from the words “picture” and “component”), to which discrete shine or shading esteems are appointed (Acharya & Ray, 2005). They can be proficiently prepared, unbiased assessed, and made accessible at many places in the meantime by methods for fitting correspondence systems and conventions,

DOI: 10.4018/978-1-6684-7544-7.ch002

for example, Picture Archiving and Communication Systems (PACS) and the Digital Imaging and Communications in Medicine (DICOM) convention, individually. In light of computerized imaging methods, the whole range of advanced picture handling is currently pertinent in solution.

The Image enhancement techniques improve the quality, clarity of biomedical images and human perception as well as machine understanding. Contrast generally refers to the difference in the luminance or grey level values in an image and is an important characteristic that is defined as the ratio of the maximum intensity over an image. Contrast enhancement techniques are also available to improve or adjust proper values of contrast in an adaptive manner.

These techniques are most useful because many medical images when examined on a color display give inadequate information for image interpretation. There is no general theory to improve the fidelity of the image with regard to some ideal form of the image but there exists a wide variety of the image with regard to some ideal form of the image but there exists a wide variety of techniques for improving the image quality. The contrast stretch, density slicing, edge enhancement and spatial filtering are the more commonly used techniques which attempt to provide corrected image against geometric and radiometric distortions. Numerous digital image techniques can be seen in literatures to be most satisfactory than the photographic technique for image enhancement because of the precision and wide variety of digital processes. This chapter also talked about the various factors causing poor quality of image such as problem with data acquisition process, imperfect instrument, and some amount of noise. This poor quality of images cannot be tolerated in medical imaging because it could lead to wrong diagnosis and interpretation. The noise reduction techniques and filters are also discussed in this chapter but since robustness is the biggest challenge in image processing, an efficient filtering method for enhancing the digital images is necessary for the removal of noise.

VARIOUS MODALITIES OF MEDICAL IMAGING

There are number of medical imaging modalities used for different purposes and applications such as ultrasound imaging, mammographic imaging etc. There have been several improvements over the technologies and imaging methods including modern image acquisition systems and sensors with which the medical imaging systems are built. The most commonly used technique for capturing breast X- ray images is Mammography. Although High quality scanners are nowa day's avalaible but improper radiation still poses problems sometimes and hence, the radiation risk is expected to be negligible (Guy, 2005).

Computer aided diagnosis systems used a digital mammographic image as input image to be analysed from a conventional film mammogram and masses, calcifications or other abnormal areas are detected. The Anomalies present may indicate the presence of cancer. The accuracy of breast cancer detection has been enhanced to a significant level with the advent digital mammographic techniques.

Breast Cancer Imaging

Brest Cancer imaging is one of the most used medical imaging modality for the detection of breast cancer. The image of a female breast organ normally consists of two large semispherical eminences containing mammary glands. These glands are used to secrete milk when stimulated corresponding to the period after giving birth. Each breast image has 15 to 20 sections called lobes. The lobes are organized in a pattern like the petals of a daisy. Lobes consist of even smaller lobules which are terminated by tiny bulb