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Bio Medical Imaging and DICOM Standard

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Abstract— ***The health services have been involving across the world issues related to quality and standardization raised in medical field. Many standards were conceived, drafted and implemented by the experts of healthcare industry. Health organization to have quality echo system started adopting standards like DICOM and HL7, lot of standardization occurred but these lead to a situation where standards were competing with each other, it require compatibility to overcome the limitation as well as seamless communication across various health organizations and their departments. This paper reviews medical imaging and related standards.***

Index Terms— Medical Imaging, DICOM standard, structured reporting

I. INTRODUCTION

Medical imaging is the technique and process used to create images of the human body or for clinical purposes or medical science s. Although imaging of removed organs and tissues can be performed for medical reasons, these procedures are not usually referred to as medical imaging, but rather are a part of pathology. It is part of biological imaging and incorporates radiology which uses the imaging technologies of X-ray radiography, magnetic resonance imaging MRI , medical ultrasonography or ultrasound, endoscopy, elastography, medical photography and nuclear medicine functional imaging techniques as positron emission tomography “PET” . Medical imaging is often perceived to designate the set of techniques that noninvasively produce images of the internal aspect of the body.

Biomedical imaging technologies uses either x-rays (CT scans), sound (ultrasound), magnetism (MRI), radioactive pharmaceuticals (nuclear medicine: SPECT, PET) or light (endoscopy, OCT) to assess the current condition of an organ or tissue and can monitor a patient over time over time for diagnostic and treatment evaluation.

Biomedical Image Processing a particular problem in high-level processing of biomedical images is inherently apparent: resulting from its composite nature, it is difficult to formulate medical a priori knowledge such that it can be integrated directly and easily into automatic algorithms of image processing. In the literature, this is referred to as the semantic gap, which means the difference between the interpretation of a diagnostic image by the physician (high level) and the simple structure of distinct pixels, which is used in computer programs to represent an image (low level).

Medical Image Formation

Since the discovery of X-rays by Wilhelm Conrad Rontgen in 1895, medical images have become a major component of diagnostics, treatment planning and procedures, and follow-up studies. Furthermore, medical images are used for education,

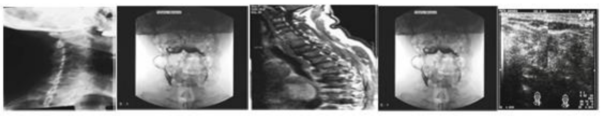

Figure:1 X-Ray axial CT MRI fluoroscopy ultrasound

documentation, and research describing morphology as well as physical and biological functions in 1D, 2D, 3D, and even 4D image data (e.g., cardiac MRI, where up to eight volumes are acquired during a single heart cycle).

Requirements in Bio Medical Imaging:

- Area calculations of the cells of a biomedical image.
- Changing density dynamic range of B/W images.
- Color correction in color images.
- Construction of 3-D images from 2-D images.
- Contour detection.
- Display of image line profile.
- Generation of negative images.
- Getting relief effect.
- Image enhancements.
- Interfacing Analog outputs of sensors devices such as endoscopes, microscopes, ultrasound etc., to digitizers and in turn to Digital Image Processing systems.
- Misrepresenting of colors within an image.
- Point to point measurements.
- Pseudo coloring.
- Registration of multiple images.
- Removal of artifacts from the image.
- Restoration of images.
- Smoothing of images.
- Zooming of images.

Biomedical imaging is vital to patient care and increasingly prevalent in the basic sciences. These images span the scale from microscopic and molecular to whole body visualization, and used in many areas of clinical medicine, such as radiology, pathology, and ophthalmology. The instantly growing image-related data in clinical records and research studies provides enormous opportunities for discovery and personalization of patient care.

Wavelets in Biomedical Applications: There are various uses of the wavelet transform (WT) in medicine and biology. The wavelet properties are most important for biomedical applications. Continuous WT are interpreted as a prewhitening multi-scale matched filter. There is the analogy between the WT and some of the biological processing that occurs in the early components of the auditory and visual system. WT can be used for the analysis of one-dimensional physiological signals obtained by phonocardiography, electrocardiography (ECG), and electroencephalography (EEG), including evoked response potentials.

New Advances of Microwaves on Bio medical Applications:

(1) Recent developments in medical imaging, including magnetic resonance imaging (MRI) and microwave imaging methods. Developments in RF coils for ultra-high-field MRI systems such as automatic frequency tuning and impedance matching technique for the optimal coil efficiency at 7T and creating homogeneous magnetic field distributions. Methods to improve range resolution for forward-scattered signals in a microwave imaging system were reported.

(2) Advanced concepts in biomedical radars and radar based techniques to address noninvasive vital signs monitoring. Recent development in noise and body motion artifact cancellation approaches for vital sign sensing using radars, and an ultra-wideband micro-Doppler radar for human gait analysis that can track more than one person and detect vital sign of moving objects.

II. Overview of the DICOM Standard

DICOM provides detailed engineering information that can be used in interface specifications to enable network connectivity among a variety of products. The Standard describes how to format and exchange medical images with associated information, both outside and within the hospital (e.g., teleradiology, telemedicine). Its interfaces are available for connection of any combination of the following categories of digital imaging devices: (a) image acquisition equipment (e.g., computed tomography, MRI, computed radiography, nuclear medicine scanners and ultrasonography); (b) image archives; (c) image processing devices and image display workstations; (d) hard-copy output devices (e.g., photographic transparency film and paper printers).

Electronic Health Record
EHR is a kind of people-arranged digital record to save the information of health maintenance, physical fitness and therapy record from birth to death for one person. EHR is an important core to develop community medical service. The use of EHR can effectively prevent and decrease the diagnostic mistakes, reduce the medical expense, and increase the efficiency of medical work.

Hospital Level 7 Standards

HL7 is known to be best international standard to facilitate clinical device data transfer to information systems in hospital. HL7 is designed to support communication requirements frequently needed especially in clinical settings.HL7 is not to provide a networking solution but to support “plug-and-play” functionality when integrating two or more computer systems into a unified hospital information system.

HL7 standards are divided into reference categories:

Primary Standards - Primary standards are considered the most popular standards integral for system integrations, inter-operability and compliance. In-demand and most frequently used standards are in this category.
Foundational Standards - Foundational standards define the fundamental tools and building blocks used to build the standards, and the technology infrastructure that implementers of HL7 standards must manage.

Clinical and Administrative Domains - Messaging and document standards for clinical specialties and groups are found in this section.

EHR Profiles - These standards provide functional models and profiles that enable the constructs for management of electronic health records.
Implementation Guides - This section is for implementation guides and/or support documents created to be used in conjunction with an existing standard. All documents in this section serve as additional material for a parent standard.
Rules and References –Technical specifications, programming structures and guidelines for software and standards development.
Education & Awareness - Find HL7's Draft Standards for Trial Use (DSTUs) and current projects here, as well as helpful resources and tools to further supplement understanding and adoption of HL7 standards.

The Health Level Seven (HL7) Standard specifies a message model, but provides only an abbreviated specification for network communications.

The CEN/TC 251/PT3-033 (European Standardization Committee: Technical Committee for Healthcare, Project Team . Request and Report Messages for Diagnostic Service Departments document specifies a semantic data

Advantages of Digital Processing for BioMedical Applications

- Digital data does not change when it is regenerated any number of times and retains the originality of the data.
- Provides a powerful tool to physicians by easing the search for representative images;
- Displaying images immediately after acquiring;
- Improvement of images to make them easier for the Physician to interpret;
- Quantifying changes over time;
- Supplying a set of images for teaching to demonstrate examples of diseases or features in any image;
- Quick comparison of images.

III. RELATED WORK

Recent work that is presently proceeding is summarized here,

Shasidhar, Metal, Clustering approach is widely used in biomedical applications particularly for brain tumor detection increasing awareness of how neural networks can be applied to these areas and to provide a foundation for further research and practical development.

There are no rules or defined criteria that can be used to select the best network type, though the authors are confident that the examples presented throughout this paper will offer rules-of-thumb and guided inspiration for future efforts. To this end, all the neural networks successfully applied to medical imaging are highlighted and compared based on their application patterns, structures, operations, training design, etc.

Nanni, Loris et al, This paper focuses on the use of image-based machine learning techniques in medical image analysis. In particular, we present some variants of local binary patterns (LBP), which are widely considered the state of the art among texture descriptors. After we provide a detailed review of the literature about existing LBP variants and discuss the most salient approaches, along with their pros and cons, we report new experiments using several LBP-based descriptors and propose a set of novel texture descriptors for the representation of biomedical images.

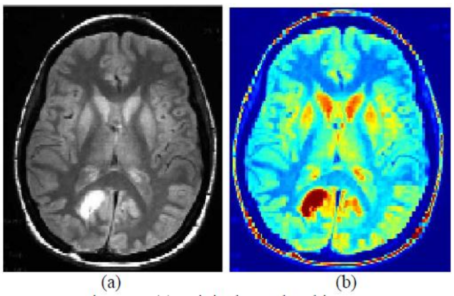

Figure2. Clustering approach for MRI Scans

in abnormal magnetic resonance (MRI) images. Fuzzy clustering using fuzzy C-means (FCM) algorithm proved to be superior over the other clustering approaches in terms of segmentation efficiency.

Average speed-ups of as much as 80 times a traditional implementation of FCM are obtained using the modified FCM algorithm, while yielding segmentation efficiency that are equivalent to those produced by the conventional technique.

Jiang, Jianmin' Given that neural networks have been widely reported in the research community of medical imaging, we provide a focused literature survey on recent neural network developments in computer-aided diagnosis, medical image segmentation and edge detection towards visual content analysis, and medical image registration for its pre-processing and post-processing, with the aims of

Huang et al, By the increasing use of direct digital imaging systems for medical diagnostics, digital image processing becomes more and more important in health care. In addition to originally digital methods, such as Computed Tomography (CT) or Magnetic Resonance Imaging (MRI), initially analogue imaging modalities such as endoscopy or radiography are nowadays equipped with digital sensors. Digital images are composed of individual pixels (this acronym is formed from the words "picture" and "element"), to which discrete brightness or color values are assigned.

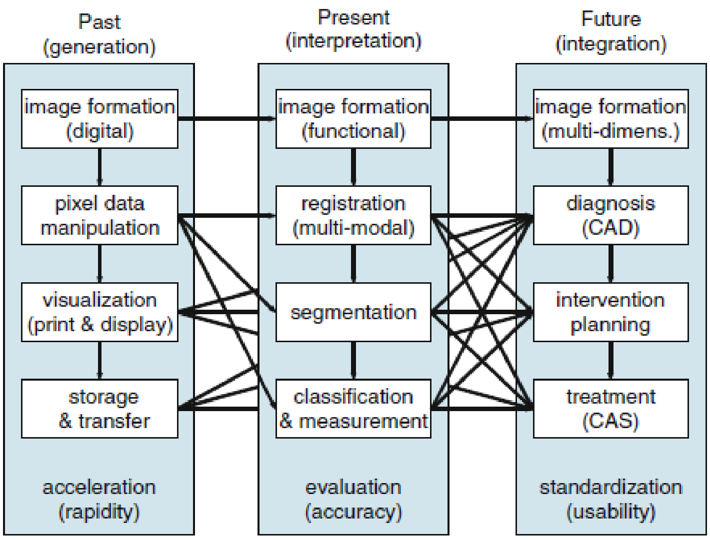

Figure 3: Changing paradigms in medical image processing

Initially (until approx. 1985), the pragmatic issues of image generation, processing, presentation, and archiving stood in the focus of research in biomedical image processing, because available computers at that time had by far not the necessary capacity to hold and modify large image data in memory. The former computation speed of image processing allowed only offline calculations. Until today, the automatic interpretation of biomedical images still is a major goal. Segmentation, classification, and measurements of biomedical images is continuously improved and validated more accurately, since validation is based on larger studies with high volumes of data.

Procházka, Aleš et al, Methods of image analysis belong to a general interdisciplinary area of multidimensional signal processing. The paper is devoted to selected intelligent techniques of biomedical image processing and namely to mathematical methods of image features extraction and image components classification invariant to their rotation. The first method under study presents an algorithm for the given image segmentation using watershed transform allowing the estimation of image segments boundaries and image components classification.

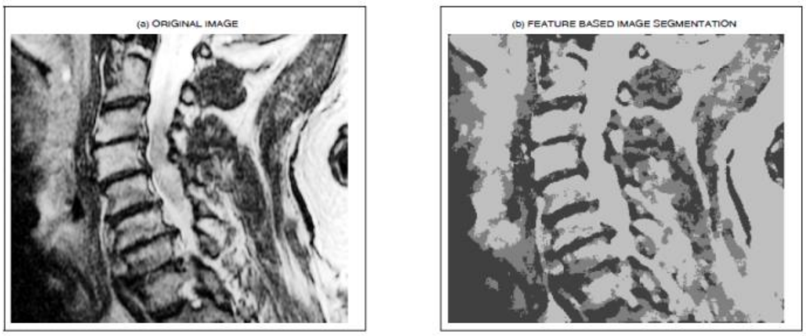

Figure:4 Watershed transform allowing the estimation of image segments boundaries and image components classification.

The contribution is devoted to image classification methods using two different principles. The first one is based upon the watershed and distance transforms use allowing to process the image without any previous knowledge of the number of image segments. Selection of features of separate segments allows the following classification into the given number of classes using a pattern matrix and appropriate clustering methods. The second method is based upon the direct estimation of pixel features using their neighbourhood.

IV. Conclusion

Recently, the digital imaging and communications in medicine (DICOM) standard introduced rules for the encapsulating, transmission, and storage of the imaging diagnostic report. This Biomedical document can be stored and communicated with the images in picture archiving and communication system (PACS). It is a structured document that contains text with links to other data such as spatial or temporal coordinates, images and waveform. Its structure, along with its labelled information, enables the semantic understanding of the data that is essential for the Electronic Healthcare Record deployment. In futue, we present DICOM Structured Report (SR) and discuss its benefits. In this we show how SR enables efficient workflow of radiology, improves patient care, optimizes reimbursement, and improves the radiology ergonomic working conditions. As structured input relevantly alters the process of interpretation, understanding all its benefits is necessary to support the change.

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