MIMBCD-UI

Medical Imaging Multimodality Breast Cancer Diagnosis User Interface

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Abstract

This report belongs to Medical Imaging Multimodality Breast Cancer Diagnosis User Interface (MIMBCD-UI) state of the art project stage, describing the related work of Clinical User Interfaces.

Breast cancer is an abnormal growth of cells in the breast, usually in the inner lining of the milk ducts or lobules. It is currently the most common type of cancer in women in developed and developing countries. The number of women affected by breast cancer is gradually increasing and remains as a significant health concern.

Researchers are continuously working to develop novel techniques to detect early stages of breast cancer. This project proposes the development of a methodology for detection and cancer targeting breast using multimodality medical imaging and textual information.

Keywords: medical, imaging, multimodality, breast cancer, diagnosis, user interface

Resumo

O teu resumo aqui...

Palavras-Chave: as tuas palavras chave

Chapter 1

Introduction

The Medical Imaging Multimodality Breast Cancer Diagnosis is a topic of great interest, it has been the subject of intensive research in the world of medicine. However the developments in terms of innovation in the computational world are still scarce. The Interface herein proposer deals with the processing and analysis of images. Indeed, this topic has a wide spectrum of applications raging from video surveillance based systems to medical applications.

In the proposed work, i.e., the analysis mammography using multi-modality images, several issues must be considered. First each image modality has its own image features. Which must be included in the interface. Second, for each image modality several and distinct image feature must be considered.

Masses and calcifications can be accurately diagnosed from cytological features [1] of the cells that constitute them. However, the diagnostic accuracy depends on the training, experience, and many indefinite factors of interpretation of the medical expert in cytological evaluation.

There were, in fact, some developments in the past facing the Computer-Based classification system [2, 3] that assists in the diagnosis of breast cells based on visual assessment of characteristics of the cells. [4] A set of cytologic features, previously evaluated visually, are now replaced by digital ones, evaluated by image analysis. In this project, the interface will be used by several experts in the field, to collect the ground truth, for Mammograms, MRI and Ultrasounds images. Those mammography experts annotations will be a crucial step towards the performance evaluation of Machine Learning (ML) Based-Algorithms.

Doctors are accountable for decisions they make on behalf of their patients. Likewise, computer interface developers and engineers must assume accountability for limitations, assumptions and other unplanned deficiencies that impact on the integrity, validity, quantity and timeliness of data made accessible through their interfaces.

Art and science [5] applied to the user interface filed of clinical care are based on an unusual combination of non-judgement trust and exasperating mistrust [6]. Two major obstacles to good clinicians-patient communication are differences of language and culture [7]. Doctors and clinicians require that theirs patients keep no secrets or else an opportunity to reach the right diagnosis or select the proper therapy may be lost. At the same time, doctors and clinicians are taught to question everything they hear from both colleagues and patients. It is deeply ingrained in medical training to make no important decisions based on information supplied solely by others. The highly trained mistrust explains why many times patients complained that a dozen different people asked the same question. A deeply ingrained aversion to secrets and lies greatly characterise a clinician's attitude toward a computer interface where the responsibility of interface developers address and incorporate the concept of visual accountability extending well beyond medical user interfaces.

The growing interest in multimodal interface development is inspired in large part by goals of supporting more flexible, transparent, efficient and powerfully expressive means of human-computer interaction than in the past. Multimodal interfaces are expected to support a wider range of diverse applications, be usable by a broader spectrum of the average population, and function more reliably under realistic and challenging usage conditions.

Computer-aided diagnosis often implies processing large and high dimensional datasets, for instance, high-resolution volumes containing millions of voxels.

Visualisation and analysis of such data can be very time demanding for physicians but also very computationally expensive for machines assisting diagnosis tasks. Fortunately, in many cases the relevant information for an application can be represented in lower dimensional spaces. If appropriately chosen and designed, dimensionality reduction methods will not only decrease the processing time but also facilitate any posterior analysis. Therefore, they can be of great use to a variety of CAD (Computer Aided Diagnosis) applications, ranging from general problems such as classification and visualisation, to more specific ones like multi-modal registration or motion compensation.

Dimensionality reduction in CAD has relied mainly on linear methods and linear methods are however not suitable for handling non-linear complex relationships among the data samples. Non-linear approaches based on manifold learning are a good alternative for dimensionality reduction in such cases.

Medical Imaging Multimodality Breast Cancer Diagnosis User Interface (MIMBCD-UI) registration consists in finding a map between images of the same scene acquired with different imaging modalities. The standard approach to multi-modal registration is to use sophisticated similarity metrics such as mutual information to compare the images.

Chapter 2

Overview

CAD Based-Systems are typically single-user oriented that is, designed to support individual tasks such as notations and information visualisation. This personal and task-oriented approach for clinical software provides little support for the aggregation of resources and tools required in carrying out higher level activities for multimodality of medical imaging. It is left to the user to aggregate such resources and tools in meaningful bundles according to the activity at hand, and users often have to reconfigure this aggregation manually when shifting between a set of parallel activities and machines.

A suited number of studies have shown that clinical professionals, upon the act of organising and thinking in their work routines, which often carried out search of general objectives, often in collaboration with others [???, ???, ???], are significant mental and manual overhead associated with handling of parallel work and interruptions [???, ???]. The rest of the user interfaces in the current operating systems, fail to provide adequate support in the resumption of the previous activities and for an easy switching between parallel activities [???, ???].

Clinical user interfaces have been extensively discussed in the literature on information visualisation. MIMBCD-UI shows the details of an user interface for diagnosing breast cancer using multimodality medical imaging.

MIMBCD-UI have several benefits. In fact, the diagnosis it self is more efficient since the clinical users may navigate using the overview of multimodality of imaging rather than the others techniques. The overview of multimodality of imaging window aids users in keeping track of their current position in the information space [???]. Moreover the overview window itself give users task-relevant information and a feeling of control [???].

A multimodality of views permits to acquire better, more efficient and flexible information and to easily diagnose in it; however, it is more difficult to users to manage information in a more complex user interface.

Specifically, this project deals with the use of a recently proposed technique in literature: Deep Convolutional Neural Networks (CNNs).

These deep networks will incorporate information from several different modes: magnetic resonance imaging volumes (MRI), ultrasound images, mammographic images (both views CC and MLO) and text.

The proposed algorithm, called for multimodality CNNs (MMCNNs) will have the ability to process multimodal information at an unified and sustained manner.

This methodology needs to ”learn” what are the masses and calcifications.

So that is necessary to collect the ground truth, or notes of the masses and calcifications provided by medical experts.

For the collection of these notes, the design and development of an interface is necessary allows the user (in this case, the medical specialist) to display various types of image (i.e., ultrasound, MRI and mammography), and that also allows for user interaction, particularly in providing the notes of the masses and calcifications.

For these reasons, it is crucial for the development of this project, cooperation with experts providing the above notes.

Chapter 3

Conclusion

There is a lot of information concerning work in development for clinical user interfaces on images tools views, but, in fact, there is little in multimodality image and its display in breast cancer diagnosis fields.

This master project report is a first essay, to what will be the master thesis related work dissertation and state of the art [???]. It describe related systems that have been designed to provide more direct support and fundament to our research. We follow at most clinical imaging tools and personal computer-based interfaces as well as a hypothetical solution of implementation with mobile interfaces where it can help us understand the right user interface solution.

In short, we analyse and rehearsed what was the first approach to the subject-matter literature on a state of the art milestone of the project to understand and to investigate the various innovations and topics made in this field of research.

A review of the state of the art in the field is provided showing the increasing interest of researchers in the domain and a wide range applications where these methods can be applied.

Cancer is projected to become the world's leading cause of death by 2016, with the burden of disease shifting further towards medically underserved populations in industrialised countries and the developing world.

New approaches are required across the spectrum of cancer management, in prevention, diagnosis, treatment, education and care. If developed and tested appropriately, optical imaging technologies can play an important role in several aspects, from providing objective diagnostic screening at the community healthcare level, to enabling pathology guidance in the clinical setting.

Importantly, by delivering these technical capabilities within cost-effective platforms, the impact on public health can be magnified through expanding patient access to previously unreachable healthcare systems.

Bibliography

Appendix A

Appendix chapter