Chapter 23
Content-Based Medical Image Retrieval Using Delaunay Triangulation Segmentation Technique

Sneha Kugunavar
Department of P. G. Studies and Research in Computer Science, Kuvempu University, India

Prabhakar C. J.
Department of P. G. Studies and Research in Computer Science, Kuvempu University, India

ABSTRACT

This article presents a novel technique for retrieval of lung images from the collection of medical CT images. The proposed content-based medical image retrieval (CBMIR) technique uses an automated image segmentation technique called Delaunay triangulation (DT) in order to segment lung organ (region of interest) from the original medical image. The proposed method extracts novel and discriminant features from the segmented lung region instead of extracting novel features from the whole original image. For the extraction of shape features, the authors employ edge histogram descriptor (EHD) and geometric moments (GM), and for the extraction of texture features, the authors use gray-level co-occurrence matrix (GLCM) technique. The shape and texture features are combined to form the hybrid feature which is used for retrieval of similar lung images. The proposed method is evaluated using two benchmark datasets of lung CT images. The simulation results prove that the proposed CBMIR framework shows improved performance in terms of retrieval accuracy and retrieval time.

INTRODUCTION

In the last few decades, the development in medical imaging technology has opened a new horizon for the study and analysis of Lung anatomy. Lung images are analyzed in the form of thorax radiographs. Early diagnosis of Lung disease and treatment can help improve the survival rate. Considerable progress

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has been made to create acute consciousness of anatomical variations in the lungs by using imaging technology like Computed Tomography (CT). Which in turn has created large Medical Image Database rich in information. With an increase in the size of the image database, the use of computers in the field of medicine to ease their processing and analysis has become obligatory (Müller et al., 2012). Computer-aided diagnosis (CAD) and Content-Based Image Retrieval (CBIR) system as auxiliary tools can help clinicians reduce the variability of analysis and improve the accuracy of interpretation (Depeursinge, Greenspan, Syeda, & Müller, 2012). As an element of the CAD system, Content-based medical image retrieval (CBMIR) system identifies and presents the set of similar images based on a certain motif which can accelerate and objectify the procedure(Müller, Michoux, Bandon, & Geissbuhler, 2004). Further, the radiologist after detecting the abnormality can imbibe their knowledge, with the formal model created after analyzing the retrieved images representing the disease process and arrive at an accurate diagnosis. In addition, this can also help the practitioners, academicians and researchers explore the characteristics of different diseases when searching for similar images, as lung nodules significantly vary in size, shape, location and also several other diseases may have similar appearance.

One of the key challenges of designing a CBMIR system is retrieval accuracy and retrieval time. Recently, several graph-based techniques and feature descriptor-based methods have been introduced. However, we believe that using an accurate segmentation technique can optimize the performance of a CBMIR system in many ways. Segmentation for the delineation of anatomical structures and Region of Interest (ROI), as a mainstay, assist and automate specific radiological tasks. Segmentation techniques vary widely depending on a specific application, the idiosyncrasies of each imaging modalities and other factors (Fasihi & Mikhael, 2017). According to our study, there are very few recent CBMIR frameworks which use the segmentation approach.

The advantages of segmentation based CBMIR techniques motivate us to consider segmented ROI to extract features instead of considering whole original image features. In this article, a novel CBMIR framework is proposed to retrieve similar lung CT images from the collection of medical images based on the segmentation of lung organ from the original medical image. CT image sequence comprises of CT images with the different anatomical structures. In this work, we use an automated segmentation technique called Delaunay Triangulation (DT) to segment the lung (ROI). The stages involved in the proposed framework are image pre-processing, segmentation, feature extraction, and similarity matching using the Euclidean distance measure. Pre-processing uses Median filtering and Histogram Equalization technique to enhance the quality of an image to assist accurate segmentation and retrieval outcomes. Segmentation is performed using DT technique which is region-based, fast, iterative, automatic and unsupervised for reliable and robust feature estimation. To address the challenges related to shape invariance, shape feature extraction methods such as Edge Histogram Descriptor (EHD) and Geometric Moments are used. The texture features are extracted using Gray-Level Co-occurrence Matrix (GLCM) method. The hybrid features are constructed by combining shape and texture features. The proposed method is simulated using two benchmark medical image datasets and the performance is evaluated.

The rest of the article is organized into the following sections. A brief review of recent CBMIR methods along with the challenges followed by methodology section, simulation results and discussion. Finally conclusion is given.