

Chapter 3

Hierarchical Correlation of Multi-Scale Spatial Pyramid for Similar Mammogram Retrieval

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ABSTRACT

In hospitals and medical institutes, a large number of mammograms are produced in ever increasing quantities and used for diagnostics and therapy. The need for effective methods to manage and retrieve those image resources has been actively pursued in the medical community. This paper proposes a hierarchical correlation calculation approach to content-based mammogram retrieval. In this approach, images are represented as a Gaussian pyramid with several reduced-resolution levels. A global search is first conducted to identify the optimal matching position, where the correlation between the query image and the target images in the database is maximal. Local search is performed in the region comprising the four child pixels at a higher resolution level to locate the position with maximal correlation at greater resolution. Finally, this position with the maximal correlation found at the finest resolution level is used as the image similarity measure for retrieving images. Experimental results have shown that this approach achieves 59% in precision and 54% in recall when the threshold of correlation is ≥ 0.5 .

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1. INTRODUCTION

Breast cancer is the most common cancer among women (Buciu & Gacsadi, 2011; Eltoukhy, Faye, & Samir, 2010; Meselhy Eltoukhy, Faye, & Belhaouari Samir, 2012). The National Cancer Institute (NCI) recommends that women over the age of 40 and older should have routine screening mammography every one to two years. The U.S. Preventive Services Task Force (USPSTF) recommends biennial screening mammography for women aged 50 to 74 years (DeAngelis & Fontanarosa, 2010). An enormous number of digital mammograms have been generated in hospitals and breast screening centers as mammography is an accurate and reliable method for the detection and diagnosis of breast cancer (Wei & Li, 2006). These valuable mammograms which show various symptoms, allow radiologists to conduct medical studies and assist them in diagnosing new cases. The most important aspect of image database management is how to effectively retrieve the similar images based on the lesion of a given example. This approach of searching images is known as content-based image retrieval (CBIR), which refers to the retrieval of images from a database using information directly derived from the content of the images themselves, rather than from accompanying text or annotation. CBIR can help radiologists to retrieve mammograms with similar contents (El-Naqa, Yang, Galatsanos, Nishikawa, & Wernick, 2004).

Due to the nature of mammograms, content-based retrieval for similar lesions is faced with some challenges. Low resolution and strong noise are two common characteristics (Wei, Li, & Wilson, 2006). With these characteristics, Lesions in mammograms cannot be precisely segmented and extracted for the visual content of their features. In addition, mammograms obtained from different scanning devices may display different features, though some approaches to image correction and normalization have been proposed; Mammograms are represented in gray level rather than color.

Even with the change of intensity, monochrome may fail to clearly display the actual circumstance of lesion area.

The purpose of this paper is to present a multi-resolution correlation calculation approach is presented to mammogram retrieval. The rest of this report is organized as follows: The third section discusses the problems of measuring image similarity by correlation. The fourth section provides a background review of the image pyramid method. The fifth section proposes a novel approach for CBIR. The sixth section describes the experiment and evaluates the effectiveness of the proposed approach for mammogram retrieval. The last section presents the conclusions for this work.

2. LITERATURE REVIEW

An image pyramid is a multi-scale spatial structure, represented at progressively lower resolution at higher levels of the structure. Since the pyramidal structures preserve spatial information and, they have been widely used for content-based image retrieval (Urdiales, Dominguez, de Trazegnies, & Sandoval, 2010). Several studies have applied pyramid-based methods for image retrieval and recognition (Brun & Kropatsch, 2006; Dong & Kim, 2001; El Aroussi, El Hassouni, Ghoulzali, Rziza, & Aboutajdine, 2011; Gangolli & Tanimoto, 1983; Kountchev, Rubin, Milanova, & Todorov, 2007; Grauman & Darrell, 2007; Kwon & Yeom, 2004; Liu et al., 2011; Elfiky, Shahbaz Khan, van de Weijer, & González, 2012; Milanova, Kountchev, Rubin, Todorov, & Kountcheva, 2009; Qiao, Lu, Pan, & Sun, 2010; Su, Zhuang, Huang, & Wu, 2005; Urdiales et al., 2010). This study (Milanova et al., 2009) presents an approach to image retrieval using cognitive representation with pyramidal decomposition. This approach is based on object model creation with inverse difference pyramid controlled by neural network. The main advantages of the method are the high flexibility and the ability to create general models

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