Global Journal of Computer Science and Technology
Graphics & Vision
Volume 12 Issue 10 Version 1.0 June 2012
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Human Vision Inspired Technique Applied to Detect Suspicious Masses in Mammograms

By Ehsan Kamrani & Mohamad Sawan
Ecole Polytechnique, Montreal, Canada; and Harvard University, USA

Abstract - Several competitive techniques have been applied for efficient image segmentation and automatic feature extraction through the literatures. There are a lot of open problems and controversial ambiguities regarding to the mechanism which applied by human eye for image segmentation and feature extraction. Here we have first extracted the human vision technique applied for image segmentation and we have implemented this technique for automatic image segmentation and feature extraction. The features have been categorized into the internal and external modalities. We have introduced the negative curvature minima (NCM) points as a dominant external feature and the textures detected using pulse coupled neural networks (PCNNs) and LAWs methods as the dominant internal feature used by human vision to segment and extracts the features of an image. These features have been used to detect suspicious masses in mammogram images using the proposed human eye inspired technique. The results justify the efficiency of the proposed method.

Keywords : *Image Processing, Mammography, Segment Detection, Human Vision, NCM.*

GJCST-E Classification: *FOR Code: I.4*

Strictly as per the compliance and regulations of:

Human Vision Inspired Technique Applied to Detect Suspicious Masses in Mammograms

Ehsan Kamrani [α] & Mohamad Sawan [α]

Abstract - Several competitive techniques have been applied for efficient image segmentation and automatic feature extraction through the literatures. There are a lot of open problems and controversial ambiguities regarding to the mechanism which applied by human eye for image segmentation and feature extraction. Here we have first extracted the human vision technique applied for image segmentation and we have implemented this technique for automatic image segmentation and feature extraction. The features have been categorized into the internal and external modalities. We have introduced the negative curvature minima (NCM) points as a dominant external feature and the textures detected using pulse coupled neural networks (PCNNs) and LAWs methods as the dominant internal feature used by human vision to segment and extracts the features of an image. These features have been used to detect suspicious masses in mammogram images using the proposed human eye inspired technique. The results justify the efficiency of the proposed method.

IndexTerms : Image Processing, Mammography, Segment Detection, Human Vision, NCM.

I. Introduction

Image segmentation plays a crucial role in many medical imaging applications by automating or facilitating the delineation of anatomical structures and other regions of interest. Many methods for image segmentation proposed by researchers have some advantages and disadvantages related to its application and purpose [1]-[3]. Almost all of these methods focus on development of a method to improve image understanding by computer and/or develop image representation for extract computerized parameters of an image. But we must note that the best intelligent and complicated image processing machine is human vision system. With no doubt, all what we know and use today as image processing techniques is only a little projection of our vision system [4]-[5].

We in our research, first study nearly all of the current methods that are in use for image segmentation, then we with study the human vision system parameters in order to detect and extract segments of an image, propose the dominant parameters that are used by human vision system for segmentation and understand the image [3]. Finally we applied these parameters to detect the segments of a medical diagnosis mammogram database and detect the tumors in the mammograms.

Author α : Dept. of Electrical Engineering, Ecole Polytechnique, Montreal, QC, H3T1J4 Canada. E-mail : ekamrany@yahoo.com

In this paper at first we survey current image segmentation methods, and mammogram image processing techniques. Then we based on Kandel theorem and Minima rule, implement some experiments to detect dominant parameters of human vision system in image segmentation. Then we introduce NCM points and textures detected using PCNN and LAW operators as dominant features in an image and try to extract them. After that we augment our detected and proposed parameters with NCM detection technique to implement our new algorithm. Finally we have developed our method on a standard database of mammography images and depicted the results.

II. Mammogram Image Processing

Breast cancer is the most common cancer in women. Early detection of the cancer leads to significant improvements in conservative treatment. We based on study the almost all current methods in mammogram image analysis saw that nearly all of these methods are focused on internal features of image rather than external features.

III. Detecting NCM Points

Many objects have component parts, and these parts often differ in their visual salience. Based on the Kandel theory [6] which introduces edges as dominant features of an image, we have developed two different psychological experiments. In one of the experiments we understand the most effective factor of image edge that affect on human vision, and in the other one we found that the negative curvature minima (NCM) points are most effective points in an image that excite the human eyes [1].

IV. PCNN and Texture Analysis

We introduce the external feature on an image as dominant features and tried to detect them, but this is not enough to refuse the external features. So we select the PCNN and texture analysis using LAWs operators [7]-[9] as dominant external features that are much similar to and based on human vision technique for image segmentation.

V. Proposed Method

Detecting and extracting the dominant feature used by human vision system to understand segments

of an image and introducing the most similar image segmentation techniques to human vision were our purpose. We have combined the internal and external dominant detected features and introduced our new method and schema based on it. After preprocessing of image and extract it's contours, at firs we using cubic B-spline technique to fit a curve on image contours, then we find the NCM points and connect them using Euler spiral. Then we select the regions based on some introduced parameters such as Proximity, Co-circularity, Transparency, and Sharpness parameters. Finally we apply the PCNN and LAWs operators to the extracted region to detect the segments (tumors) more accurately. This technique also improves the efficiency of PCNN and LAWs operators by limiting the processing region to a small region.

VI. Implementation and Results

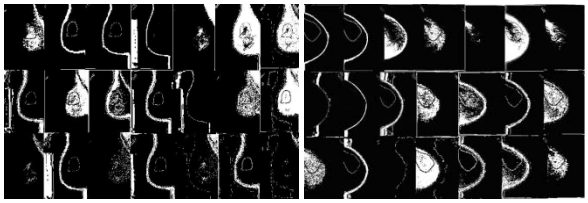
In order to study and analysis the efficiency of our method, we used 200 mammograms of DDSM Data base. We designed a package called HMAM for implement our method. With introducing two parameters of TPR (True Positive Region) and FPR (False Positive Region) we measure these parameters in different images and compare the results with traditional methods. Some of the results are shown in Table 1 and Table 2. Some of the results of the applying proposed method on a cancerous mammogram are shown in figure 1. We repeat applying the method on images and saw that the results are dependent on number of iteration (figure 3).

Table 1: FPR% and TPR% variation with tumor type and size of extraction for traditional texture analysis method

		Star masses		Regulated masses	
		FPR%	TPR%	FPR%	% TPR
Small Extracts	Low lev.	11	19	5	10
	Up lev	58	88	11	85
Big Extracts	Low lev.	1	97	0	84
	Up lev	19	89	5	93

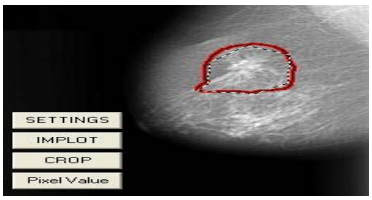
Table 2: FPR% and TPR% variation with tumor type and size of extraction for the proposed method

		Star masses			Regulated Masses
		FPR%	% TPR	FPR%	TPR%
Small Extracts	Low Lev	8	23	0	14
	Up lev.	50	88	12	89
Big Extracts	Low lev.	10	21	2	34
	Up lev.	150	72	155	93

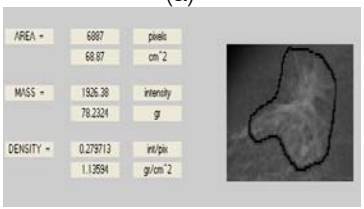


(a) (b)

Figure 1: Mass detection and extraction process regarding to the small (a) and big (b) masses



(a)



(b)

Figure 2: Detected mass (a) and its characteristics (b)

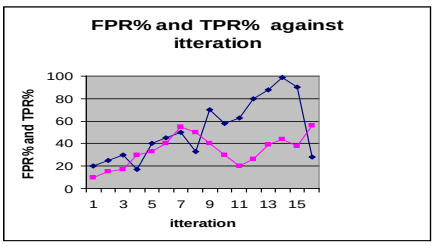


Figure 3: dependent of results on iteration

References Références Referencias

1. E. Kamrani, M. Enshaeyeh, and G. H. Rezaie Rad, "Identification of Dominant Features in Image Segments Detection by Human Vision", Proceedings of the 6th annual Iranian Computer Conference (CFSC2003), Tehran, IRAN, Nov. 26-27, 2003, pp. 163-168
2. E. Kamrani, M. Enshaeyeh, GH.Rezaie Rad, "Identification of dominant features of human vision for Image segments detection", proceeding to 9th annual conference of computer association of Iran, Sharif university, iran, February 2004.
3. M. S. Gregory, D. Seyranian, D. Hoffman,"Parsing silhouettes: The short-cut rule", Department of Cognitive Sciences, University of California Irvine, California, 1999
4. M. Singh, D. Hoffman,"Part boundaries alter the perception of transparency", Department of Cognitive Sciences University of California Irvine, California 92697-5100, 1998

5. E. R. Kandel,"Principles of Human NeuroScience", McGraw-Hill, Health Professions Division, USA, Jan 5, 2000.
6. R. Eckhorn, "Neural Mechanisms of Scan Segmentation: Recordings from the Visual Cortex Suggest Basic Circuits for LinkingField Model" IEEE Transaction on Neural Networks vol.10, no.3 ,May 1999
7. Johnson,J.L,Padgett,M.L"PCNN Models and Application", IEEE Transaction on Neural Networks vol.10, no.3, May1999
8. R Guptat and P E Undrill, "The use of texture analysis to delineate suspicious masses in mammography", Department of Bio-Medical Physics and Bioengineering, University of Aberdeen, Forester hill, Aberdeen AB9 ZZD, UK, in final form February 1995.