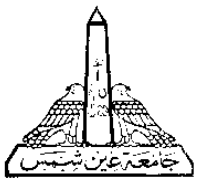

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Electronics Engineering and Electrical Communications

Enhancement Algorithm for Breast Cancer Detection

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by

Mai Adel Mohamed Ibrahim

Bachelor of Science in Electrical Engineering

(Electronics Engineering and Electrical Communications)

Faculty of Engineering, Ain Shams, 2012

Supervised By

Prof. Dr. Salwa Hussein El-Ramly

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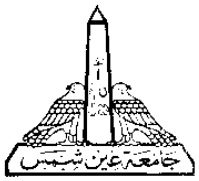
Cairo - (2018)



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Statement

This thesis is submitted as a partial fulfillment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Thesis Summary

Breast cancer has a great attention worldwide due to the increase of the number of patients, especially women, suffering from this disease. However, breast cancer can be cured if it is detected in its early stages. Many pathological studies reported that more than 75% – 80% of all tumors are still benign at the primary stages. Therefore, recently, many studies and extensive researches are done to detect breast cancer with higher accuracy. Breast thermography is a promising screening technique for the early detection of breast cancer. Breast thermography is the physiological exam that records the temperature variation utilizing the infrared radiation released from the breast surface. Usually, this temperature variation is affected by the level of blood perfusion in the breast skin. Blood perfusion level is influenced by different causes, for example, inflammation, and the presence of tumor. The infrared camera can capture these progressions extremely well and consequently, breast thermography can be utilized to recognize the breast variation from the norm in its beginning time.

Specialists have exhibited that breast thermography has an awesome potential in the early prognosis indication. Breast thermogram examination depends on the asymmetry analysis between the two breasts. However, manual interpretation of the breast thermograms is highly subjective, boring and challenging, especially when the image is relatively symmetric. Therefore, to address this limitation, intelligent systems, computer vision and pattern recognition techniques are continually developed by researchers. Computer Aided Diagnosis (CAD) system is utilized to help therapists to analyze the breast thermograms for early breast cancer detection. This results in a good and consistent diagnosis performance utilizing breast thermograms.

In this thesis, breast thermography CAD system is designed. Generally, CAD is initiated by the thermogram image segmentation. Thus, segmentation is considered the most important step in CAD as it affects the latter steps. In this thesis, an automatic segmentation algorithm for frontal breast thermograms is proposed. Initially, using full automatic process, the region of the two breasts is extracted and the image quality is enhanced. After that, full automatic segmentation algorithm is proposed to separate the two breasts from each other. Performance evaluation of the proposed algorithm proves its ability to successfully segment all types of breasts (small, medium, large, asymmetric and flat). Moreover, quantitative measures are computed to verify the capability of the proposed algorithm. To complete the classification, a series of statistical, texture and run length features were extracted and the most effective ones are fed forward to an

artificial neural network and a support vector machine for automatic classification into sick or healthy. The effectiveness of the proposed algorithm is compared to previous works in terms of the classification accuracy and the sensitivity and proves its superiority over the existing algorithms.

Keywords: Breast cancer, Breast thermography, Classification, Computer Aided Diagnosis, Segmentation, Thermograms.

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List of Symbols

A	Activation function of a neuron
AT	Actual target label of the training samples
B	Length of group of continuous and collinear pixels having the same grey level intensity in image
b	Bias of support vector machine hyperplane
C	Support vector machine hyperplane parameter
d	Distance between two pixels have a specified intensity values in Grey level co-occurrence and grey level run length matrices
ENT_v	Entropy of column marginal probability of Grey level co-occurrence matrix
ENT_u	Entropy of row marginal probability of Grey level co-occurrence matrix
G	Total number of grey levels in an image
G_N	Number of grey levels in the quantized image
H_o	Null hypothesis of the t-test
H	Hyperplanes of support vector machines
K	Number of clusters
M	Margin of SVM hyperplane
M(u, v)	The sum of the number of times that the pixel with value u happened in the predefined spatial relationship to a pixel with value v in the input image
m	Mean value of $P(u, v)$
n	Sample size
N	Number of extracted features from images