Chapter 16
To Design a Mammogram Edge Detection Algorithm Using an Artificial Neural Network (ANN)

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ABSTRACT

An artificial neural network (ANN) is used to resolve problems related to complex scenarios and logical thinking. Nowadays, a cause for concern is the mortality rate among women due to cancer. Generally, women to around 45 years old are the most vulnerable to this disease. Early detection is the only hope for the patient to survive, otherwise it may reach an unrecoverable stage. Currently, there are numerous techniques available for the diagnosis of such diseases out of which mammography is the most trustworthy method for detecting early stage cancer. The analysis of these mammogram images is always difficult to analyze due to low contrast and non-uniform background. The mammogram images are scanned, digitized for processing, nut that further reduces the contrast between region of interest (ROI) and the background. Furthermore, presence of noise, glands, and muscles leads to background contrast variations. The boundaries of the suspected tumor area are always fuzzy and improper. The aim of this article is to develop a robust edge detection technique which works optimally on mammogram images to segment a tumor area.

INTRODUCTION

The flow diagram consists of three major steps i.e. bilateral filtering, entropy multithresholding and artificial neural network (ANN) based edge detection (Sharifi, Fathy, & Mahmoudi, 2002). The acquired image is preprocessed by using bilateral filter to smoothen any spurious pixels present in acquired image.

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As mammographic images have low contrast and single thresholding Binarization is not inadequate for mammogram images. Therefore, three threshold levels are calculated by using entropy technique for binarization (Heindel, Wige, & Kaup, 2016). This multi threshold entropy binarization method helps to manifest maximum detail out of low contrast breast images. The true edges are filtered out by using Artificial Neural Network which is trained by using 3 × 3 Binary images. Finally, the output of ANN is edge map of lessen masses present in mammogram images. The complete details of these steps are described in following subsections. (Joshi, Yadav, & Allwadhi, 2016).

The detail flow diagram of proposed method is shown in Figure 1.

BACK PROPAGATION NEURAL NETWORK (BPNN)

Back propagation neural network (BPNN) is a multi-layer network introduced. It is basically a supervised network use to train the network for edge detection by using the different Training Samples. Training means adjustment of Weights and Biases of Neural Network according to different input and output relation (Chickanosky & Mirchandani, 1998).

Suppose x is input training sample where $x = (x_1,x_2,\ldots,x_n)$, t is the output target given by $t = (t_1, t_2, \ldots,t_m)$. δ_k is the error at output unit y_k, δ_j is the error at hidden unit z_j, α is the learning rate, v_{oj} is the bias of hidden layer neuron j, w_{ok} is the bias of hidden layer neuron k, z_j and y_k is the output of hidden layer and output neuron.

Output of hidden layer neuron is given by

$$z_{inj} = v_{oj} + \sum_{i=1}^{n} x_i v_{ij} \tag{1}$$

f is the activation function and output of j^{th} hidden neuron which is given by

$$z_j = f(z_{inj}) \tag{2}$$

$$y_{ink} = v_{oj} + \sum_{j=1}^{p} z_j w_{jk} \tag{3}$$

And output of k^{th} output node is given by

$$y_k = f(y_{ink}) \tag{4}$$

Error at k^{th} output node is given by

$$\delta_k = (t_k - y_k)\, f^1(y_{ink}) \tag{5}$$