Chapter 8
Grayscale Image Segmentation With Quantum-Inspired Multilayer Self-Organizing Neural Network Architecture Endorsed by Context Sensitive Thresholding

Pankaj Pal
RCC Institute of Information Technology, India

Siddhartha Bhattacharyya
https://orcid.org/0000-0003-0360-7919
RCC Institute of Information Technology, India

Nishtha Agrawal
RCC Institute of Information Technology, India

ABSTRACT

A method for grayscale image segmentation is presented using a quantum-inspired self-organizing neural network architecture by proper selection of the threshold values of the multilevel sigmoidal activation function (MUSIG). The context-sensitive threshold values in the different positions of the image are measured based on the homogeneity of the image content and used to extract the object by means of effective thresholding of the multilevel sigmoidal activation function guided by the quantum superposition principle. The neural network architecture uses fuzzy theoretic concepts to assist in the segmentation process. The authors propose a grayscale image segmentation method endorsed by context-sensitive thresholding technique. This quantum-inspired multilayer neural network is adapted with self-organization. The architecture ensures the segmentation process for the real-life images as well as synthetic images by selecting intensity parameter as the threshold value.

DOI: 10.4018/978-1-7998-8593-1.ch008

INTRODUCTION

Image processing using image segmentation is a difficult task to recover the objects from multilevel images. So many research approaches have been taken out to reconstruct the object from the multilevel background, but it still remains a fallacy to recover the true objects ideally. The multilayer self organizing neural network (MLSONN) architecture is unable to extract the gray scale objects from the blurred and noisy atmosphere which is designed by Ghosh et al., 1993 (Ghosh et al., 1993) and is used to extract the binary objects efficiently. Here, interconnection weights of different layers viz. between input to hidden layer and hidden to output layer are updated by means of fuzzy measures. This architecture is limited only for the bi-level sigmoid activation function to segment the binary images. The authors (Pal et al., 1993) have described the color image segmentation technique using fuzzy and non-fuzzy methods considering segmentation of range images and neural network based approaches. The authors (Pantofaru et al., 2005) have presented the result of the mean shift segmentation and the efficient graph-based segmentation techniques for objective evaluation algorithm describing the three components viz. the Correctness, the Stability with respect to parameter choice and the Stability with respect to image choice. If these characteristics are fully satisfied by the segmentation technique, then it can be more useful by larger systems. The authors have considered the pixel location and color feature for each and every image for this segmentation algorithm using the Berkeley segmentation database. The authors (Bhattacharyya et al., 2007) have described on the true color image segmentation by self supervised PSONN architecture using multilevel sigmoidal activation function. Regarding this proposed architecture, it is the extension version of standard single self organizing neural network architecture (SONN) and comprises input or source layer, three middle layers for segmentation of three primary color components and the output layer or sink layer. To segment the color image for first object recovery in large image database, the probability of pixel distribution is implemented (Kang et al., 2008). After incorporating three channel images of R, G and B from the given image, and then applying pixel distribution is taken out using similarity measures using the well known defined distribution function Weibull, Exponential, Beta, Gamma, Normal, and Uniform. Using the measurement of sum least of square error, to fit the image to the distribution. Under consideration of minimum amount of error, image is quantized to gray levels for three channels of distribution using threshold value and then these three channel values are fused together to get the desired information. Few years' latter authors (Bhattacharyya et al., 2010) proposed multilevel image segmentation using a MUSIG activation function which is more efficient to extract the multilevel images by means of functionally modifying the network. The MUSIG activation function is characterized by ignoring heterogeneity of the image information content for understanding equal and fixed class responses. The authors De S. et al. (De S. et al., 2010) described under consideration of the heterogeneity of the image information content in the segmented images by applying optimized MUSIG (OptiMUSIG) activation function. OptiMUSIG activation function is used in another way to segment the true color image segmentation (De S. et al, 2012) on optimized class responses on self organizing neural network architecture. The authors De S. et al. considered generic based optimized segmentation method. Gray scale image is segmented (De S. et al., 2012) on optimized class responses without considering the heterogeneity of image information content by optimization of MUSIG (OptiMUSIG) activation function. It may or may not generate good quality of segmented outputs. There are so many research works have been done to recover the object from the different images. Segmentation is one of the approaches where object is reconstructed from the image. The gray scale image is segmented to recover the object by means of context sensitive thresholding implementation technique. In this chapter, the authors propose a