Bi Level Kapurs Entropy based Image Segmentation using Particle Swarm Optimization

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Abstract—In the field of Image Processing, Image segmentation is a low level but important task in entire image understanding system which divides an image into its multiple disjoint regions based on homogeneity. In most of the machine vesion and high level image understanding application this is one of the important steps.Till date different techniques of image segmentation are available and hence There exists a huge survey literature in different approaches of Image Segmentation. Selection of image segmentation technique is highly problem specific.There is no versatile algorithm which is applicable for all kinds of images. Optimization based image segmentation is not explored much which can be applied to reduce complexity of the problem. The aim of the paper is to search for an optimized threshold value for Image Segmentation using Particle Swarm Optimization (PSO) algorithm where fitness function is designed based on entropy of the image.

I. INTRODUCTION

Image Segmentation [1], [2] is the process of dividing an image into multiple disjoint, non-overlapping regions such that pixels that belongs to the same region will be same based on some image property like gray scale value, color, texture etc. of the pixels. Actually it helps to find out the region of interest and reduce the size of the data space to be analyzed further. Image Segmentation process widely used in Medical Imaging [3], Moving Object Detection [4], and Pattern Extraction from an image [5], Image Compression [6] and many more real life applications. Mainly image segmentation techniques can be classified into two categories i.e. similarity based approaches and discontinuity based approaches. There are several techniques for image segmentation like edge/line/point detection [7],region based segmentation [8],graph based segmentation [9],clustering based approaches [10]. In edge detection technique abrupt changes in gray scale values are captarued and the boundary of the objects are considered in this way. There exist mainly four different kinds of edges ramp edge, step edge, line edge and Roof Edge. Several masking techniques are used for detecting edges.Region based segmentation can be categirised into two main categories: region growing and region spletting and mearging.In graph based segmentation technique a digital image is modelled as a graph and efficient graph partitioning algorithm is used for paritioning the graph.Again Image segmentation problem can be thought as a clustering problem where similar pixels can be grouped in the same cluster.A complete survey on different clustering algorithms can be found in [11]. A survey on different image segmentation technique can be found in [12]. Recently optimization based techniques are popular for image segmentation. Among all techniques optimization based approach is quite recent. Optimization based approaches in Image Segmentation can be of different types based on the objective functions designed to segment the image. Image Segmentation problem can be considered as a clustering problem where homogeneous pixels are grouped [13] in a cluster by maximizing the connectedness or minimizing the separation among the pixels. For an 8-bit gray scale image, threshold can be any value in between 0 and 255, determined experimentally depending on the problem. Brute force method of selecting the optimized threshold value may not be realistic in many real life applications. So, in this paper we have chosen the optimized gray scale threshold value by maximizing Kapurs Entropy Function.

Rest of this paper is organized as follows: Section II presents a detiled discussion on image segmentation. section III presents methodology used in the paper. Section IV presents Particle Swarm Optimization (PSO) algorithm. Section V presents proposed algorithm, section VI presents simulation and results obtained by the proposed algorithm and finally section VII presents conclusion of our work and gives future directions.

II. IMAGE SEGMENTATION

Image segmentation is considered to be a medium level activity in an image processing system.When an image is segmented mainly five conditions should be satisfied. First, the segmentation process must be complete that means each pixel belongs to atleast any one of the region.Second, the pixels in a region must be connected i.e. each region is a connected set of pixels.Third, two regions cannot intersect with each other. This condition may be violated in case of fuzzy segmentation.Fourth,each region of the segmented image must satisfy a predicate based on the gray scale value, texture etc.Fifth two adjacent region cannot simultaneously qualify the same predicate.

III. BACKGROUND METHODOLOGY

Entropy based image segmentation has been proposed in the paper where entropy of an image is defined below using Shannons Entropy Function [14]. The numirical value of