Image Segmentation using MSNCut Algorithm

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ABSTRACT
In this paper a hybrid technique for the segmentation of image has been proposed and it is named as MSNCut technique. Here image segmentation is the process of dividing the given image into number of regions that possess similar properties such as color, texture and intensity which are useful for the image analysis. The image is generic here, in other words image may be tree, river, building, medical or any general image. In this proposed method first the input image is pre-processed by mean shift algorithm to divide it into its constituent regions. Then the resultant image is represented as a bi-partite graph and finally the resultant graph (image) is processed under normalized cut to classify the image into meaningful classes.

General Terms
Image Segmentation, Algorithm, Performance, Space Complexity, Pixels, Hybrid et. al.

Keywords
Segmentation, MSNCut, Mean Shift, Minimal cut, Clustering.

1. INTRODUCTION
The main motto of image segmentation is to analyses the image which is an important phase in image processing. The image may be generic or medical. Image segmentation helps to develop the applications such as OCR (Optical Character Recognition), satellite image classification, remote sensing, face recognition, traffic signal location, medical image segmentation and many other. During the last few decades' image segmentation turned out to be one of major tool in medical area used for the further analysis.

Image segmentation is a process in which the image is mainly divided into two sub-regions referred as foreground and background. Here foreground is the required area of analysis in other words output. And the background is the unwanted area in other words the region that is not used in image analysis in image processing. Further image processing can be divided into three stages which are shown in Fig. 1. First level is the low-level in which image is operated at the pixel-level. The second level is middle level in which the image is analyzed after it is being segmented. Finally, in the third level called as high level the image is understood for further processing such as classification, feature extraction etc.

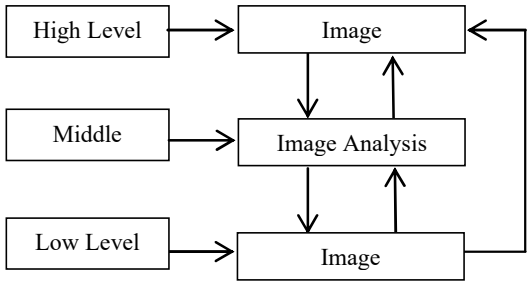

Figure 1. Image Segmentation Process for image classification

The proposed work is hybrid which combines the mean shift algorithm and normalized cut algorithm to perform faster and in a more efficient manner. During the section 2 explanation of the related work has been presented. Section 3 contains the proposed our work. Section 4 consists of results and discussions. Finally, in section 5 details of references is mentioned.

2. LITERATURE SURVEY
There are plenty of image segmentation algorithms available which are used in image analysis but graph based image segmentation algorithms are more efficient and cost effective. These algorithms are more effective when combined with other techniques such as statistical, fuzzy based and with traditional methods also.

2.1. Image Clustering using Mean Shift Algorithm
Mean shift algorithm is a clustering algorithm which functions in feature space. In this paper the transitory analysis of image segmentation technique based on mean shift algorithm [4] has been presented. It involves two stages. During first stage, the input image is improved into feature space using a non-parametric technique i.e., it is converted into kernel density to assess the model features. And in the second stage, the image segmentation problem can be deliberated as a clustering problem by determining the methods of density function and allocating point to the modes. For instance, for defining kernel density approximation at point x in a dataset$\{x_i\}_{i=1}^{n} \subseteq R^D$.

$$f' = \frac{1}{n}\sum_{i=1}^{n} K_H(x - x_i) \qquad (1)$$

where$D$ is the dimension of the data. For easiness, the kernel widths as the same have assumed. Now the kernel density estimation becomes:

$$f'(x) = \frac{1}{n}\sum_{i=1}^{n} k\left(\left\|\frac{x-x_i}{h}\right\|\right)^2 \qquad (2)$$

The mean shift vector is given by:

$$\mathrm{m(x)} = \frac{\sum_{i=1}^{n} x_i k\left(\left\|\frac{x-x_i}{h}\right\|\right)^2}{\sum_{i=1}^{n} k\left(\left\|\frac{x-x_i}{h}\right\|\right)^2} - \mathrm{x} \qquad (3)$$

Now iteration of $x^{T+1} = m(x^T)$ has been done .For every point, the structure congregates to a mode of the density function (3). Later for each point which congregates to the same mode, a cluster has been allocated. Consequently, the final segmented image has been obtained.

2.2. Spectral Graph Partitioning
In this paper, one of the above methods that is Normalized cut (Ncut) for our experimentation is used. The image is denoted by a graph with $G = (V, E, W)$, where V represents the collection of nodes and E corresponds to the collection of edges which connects the nodes. The nodes u and v are connected using an edge e and is weighted by $\mathrm{w(u,v)} = \mathrm{w(v,u)} \geq 0$ which measures the dissimilarity amongst the nodes. $W$is an edge similarity matrix with $\mathrm{w(u,v)}$as its $(\mathrm{u,v})$ the element [1]. The graph which represents an image is subdivided into two separate sub-graphs A and $B = V - A$