ISSN: 2278 – 1323
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 2, Issue 11, November 2013

Analysis on Image Segmentation using Spectral Clustering

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Abstract— **The task of Clustering is an important aspect which is widely used in image segmentation and other areas. In this paper, we study spectral clustering algorithm which clusters data using eigenvectors of similarity matrix. This work proposes a two stage method. The extraction of the textual feature of original image is done which gives the first stage segmentation. And the second stage uses spectral clustering techniques to cluster the primitive regions.**

Index Terms— **spectral clustering, similarity matrix, CCM, image segmentation**

I. INTRODUCTION

Image segmentation subdivides images into meaningful regions. Therefore image segmentation has many applications such as in computer vision, medical image analysis and diagnosis, remote sensing etc.

Down-sizing the image, however, will cause a loss of finer details and can lead to inaccurate segmentation results. The proposed method solves this problem by successfully applying spectral clustering to large images using a texture segment.

The first image segmentation [4] algorithm based on spectral clustering was developed by Shi and Malik, based on normalized cut [1]. Zelnik-Manor and Perona proposed a method for automatically determining an appropriate number of clusters (segments). Xiang and Gong proposed a method for both estimating an appropriate number of clusters and dealing with noisy data. In their method, only those eigenvectors that are likely to help separate y1,y,yn are selected to be included.

This paper is structured as follows. In Section II, Related existing work. Section III explains Proposed work. Section IV, explains conclusion of this work.

II. RELATED WORK

The various Literature review are as follows:

1. A Fast Large Size Image segmentation Algorithm Based on Spectral Clustering:

This paper, says that whenever spectral clustering deals with large size image it takes a lot of time and cost .To solve this problem this paper has been developed which separate the large size image into smaller images combine the segmentation results of each smaller image. Then a point is randomly selected in the integrated results to constitute the feature data of the large size image[2].

If the size of image is very large, we face the problem of high computational cost. Therefore, most of the spectral clustering algorithms are applied in the small scale image. Yan et al [6] proposed a general framework for fast approximate spectral clustering which can get minimum distortion rate and reduce the scale of data. In this paper deals with the problem of the large size image segmentation and propose a fast image segmentation algorithm based on spectral clustering [9].

The algorithm FSC in this paper mainly contains *blockwise segmentation* in which image is partitioned into blocks, *initial pre-partition* in which all gray level of pixels are converted to 8-bit binary code and replace lower m bits by 0, *data clustering with representative points* in which randomly a pixel is selected from clusters , and *the determination of the original image pixel category* in which all pixels in cluster have same class labels.

Thus the benefit of FSC can obtain good result at the same time reducing the computation cost, still there is limitation that not improved performance. So, we can improve the segmentation performance by using Texture information.

2. Enabling scalable spectral clustering for image segmentation:

This paper focuses on common challenge based on spectral clustering with image segmentation method is scalability, as large size image is difficult to

manage. Down-sizing the image will cause some unacceptable results so, this paper provides a combination of blockwise processing and stochastic ensemble consensus to address this challenge.

The idea used in this paper [3] is to perform an over-segmentation of the image at the pixel level using spectral clustering [10], and then merge the segments using a combination of stochastic ensemble consensus and a second round of spectral clustering [11]. In first step, the image is divided into non overlapping blocks of fixed size. The stochastic sampling scheme attempts to integrate global and local image information to determine the underlying classification of image pixels is done in second step of Stochastic ensemble consensus. After SEC, the clustering is now performed at the segment level instead of at the pixel level. Finally, a post-processing is performed to obtain the final segmentation.

Thus, this paper presents the novel spectral clustering image segmentation algorithm that preserves details more accurately as compared to other spectral clustering algorithm which is beneficial to image segmentation. Still the segmentation performance is not improved , we can improve by using Texture information. Advanced edge detection techniques can be used to improve segmentation performance.

3. Image segmentation with Texture Gradient and Spectral Clustering:

Two stages were used in this method for image segmentation. Texture watershed segmentation is used in the first stage. Texture watershed algorithm [15] extracts both the texture gradient and intensity gradient separately and integrates them to apply watershed segmentation.

Dual Tree Complex Wavelet Transform, an extension of discrete wavelet transform, extracts texture feature from the image and orientation median filtering reduces the double edge effect at the texture edges. Watershed transform of Gaussian gradient of combined texture and non-texture feature give the first stage segmentation.

Since watershed segmentation results in irregular regions. Hence GLCM(Gray level co-occurrence matrix) is used for extraction of textual features [14]. GLCM gives how the reference pixels and its neighbor occur in an image.

And in the second stage it applies the spectral clustering technique which gives various clusters. Multiway spectral clustering is applied here.

Though the work gives better performance but we can also improve the segmentation performance using other image features like color or intensity.

III. PROPOSED WORK

Motivated by the analysis, improving segmentation performance by texture information using Spectral clustering is proposed which differ from the previous approaches in that Texture information is used for Segmentation using Spectral clustering. In the first stage extraction of texture feature is done for initial segmentation and in the second stage we apply the Spectral clustering techniques.

A) Texture Computation USING CCM

Texture gradient is a directional change in the intensity or color in an image, which is used to extract information from images Here texture image is smoothened by median filtering; this removes double edge in the gradient image. Hence the extraction of the textural features of original image is done by using color co-occurrence matrices (CCM), which can construct features from different directions. CCM gives the value of how often combination of reference pixel and its neighbor occur in an image.

B) SPECTRAL CLUSTERING

Spectral clustering uses the eigen vector matrix [9]. There are three types of Spectral clustering algorithm. Recursive spectral algorithms, such as SM algorithm [1], use the information in a single eigenvector. These algorithms first divide data into two and then recursively generate more number of partitions. Multi-way spectral algorithms, such as NJW algorithm [7], use multiple eigenvectors. Non-spectral algorithms are simple clustering algorithm that clusters the data quickly.

Thus, this work uses CCM for texture feature extraction and given a set of block features that is to be partitioned into k clusters.

IV. CONCLUSION

This paper has presented a complete survey of image segmentation using spectral clustering. Although texture feature is used in segmentation, other image features like color, intensity can also be used. A broad idea of segmentation by texture information using spectral clustering can be presented, which gives fast and scalable image segmentation based on texture information, preserve details more accurately. This could be taken to a selected domain of images and approach can be evaluated. .

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