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RESEARCH ARTICLE

Region Based Satellite Image Segmentation Using JSEG Algorithm

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Abstract— Image segmentation is a major research area due to its extensive usage and application in the area of computer vision. It is the basis of Image analysis and understanding. Satellite Image segmentation is a challenging and tough task due to the inherent nature of the image. A wide variety of various segmentation techniques for colour satellite images have been developed. Here, we come up with an approach called JSEG, "JPEG image segmentation" along with region growing to perform segmentation of satellite images. At first colour quantization is done to represent various regions in the image. Then a class map of that image is formed by replacing the image pixel colors by their corresponding color class labels. Applying this to local windows, results in "J-image". Finally Region growing method is used to segment based on the multi-scale J-images.

Keywords: Image Segmentation; Satellite Image; JSEG; J image; Region Growing

I. INTRODUCTION

Image segmentation is a key step in Computer Vision which performs partitioning a digital image into multiple segments. It is in general used to locate and place objects and boundaries in images. There are large number of remotely sensed images that can be acquired through radars and satellites. These images contain a lot of geographical information which are useful in many applications. Hence, in remote sensing application segmentation is a fundamental process whose main idea is to allow a meaningful discrimination among essential region of interest.

Color image segmentation is a process of extracting one or more connected regions satisfying homogeneity criterion from the image based on single/multiple features derived from spectral components. Commonly used color image segmentation methods are histogram threshold, clustering method, based on edge detection methods, fuzzy methods, artificial neural network approach, based on physical model methods, etc. However, due to complexity of the satellite images, it is still a very challenging task to develop an efficient segmentation algorithm.

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II. PROPOSED WORK

The crucial idea behind JSEG is to split the segmentation process into two independent stages that is color quantization and spatial segmentation. Firstly, colors in the image are quantized into several classes that can be used to discriminate regions in the image. This process is performed in color space alone, without considering spatial distributions. Afterwards image pixel colors are replaced by their corresponding color class labels and forms a class map of the image. The acquired image deals with the following considerations such as image with homogeneous color- texture regions, quantized colors represents the color information, colors between two adjacent regions are distinguishable.

The main spotlight of this work is on spatial segmentation of satellite image, where a principle for good segmentation using class map is proposed. Applying this to the local windows in the class map, will results in J- image, in which high and low values corresponds to probable boundaries and interiors of color- texture regions. Then Region growing method is used to segment the image based on multi scale j images. The goal is to develop a consistent algorithm for segmentation. The block diagram of the proposed work is shown in Figure 1. Experimental results show the robustness of the JSEG algorithm on the real images.

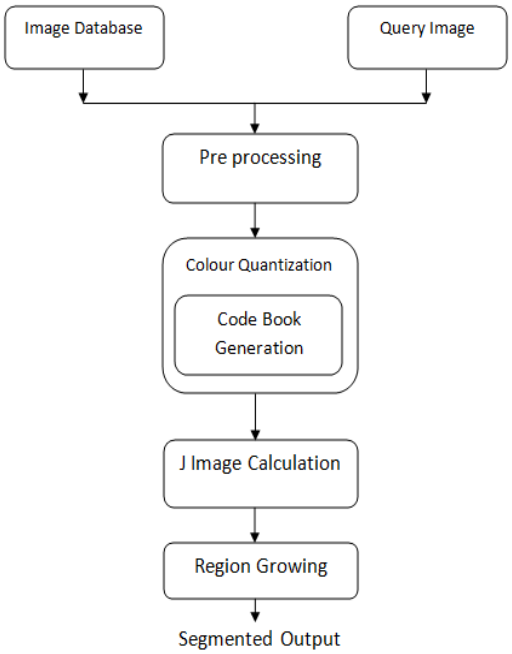

Figure 1: Block Diagram of Proposed work

III. JSEG ALGORITHM

A. *Color Quantization*

In computer vision, color quantization/color image quantization is a process that reduces the number of different colors used in an image. This is done with the intention that the quantized image should be visually similar as much as possible to the original image. Color quantization is critical to display images with more number of colors on devices that can only display a limited number of colors, usually due to lack of memory, and enables efficient compression of certain images.

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B. J Image Calculation

In order to perform Jpeg segmentation, it is necessary to calculate the J-value of the query image. Here the set of all points of quantized image is defined by Z, then z = (x, y) with z ∈ Z and with m being the average in all Z elements shown in Eqn (1). C is the number of classes obtained in the quantization. Then Z is classified into C number of classes, Z_i are the elements of Z belonging to class i, where i=1,...,C, and Let m_i be the mean of the N_i data points of class Z_i.

$$\mathrm{m} = \frac{1}{N}\sum_{z\in Z} z \qquad (1)$$

$$m_i = \frac{1}{N_i}\sum_{z\in Z} z \qquad (2)$$

J value is given by Eqn (3),

$$J = \frac{S_B}{S_W} = \frac{(S_T - S_W)}{S_W} \qquad (3)$$

where

$$S_T = \sum_{z\in Z} \| z - m \|^2 \qquad (4)$$

$$S_W = \sum_{i=1}^{C}\sum_{z\in Z} \| z - m_i \|^2 \qquad (5)$$

The parameter S_T, given in Eqn (4) represents the sum of quantized image points within the average of all Z elements. Thereby, the relation between S_T and S_W, denotes the measures of distances of this class relation. J for higher values indicates an increasing distance between the classes and points for each other, making an allowance for images with homogeneity[1].

C. Region Growing

Region growing is one of the efficient segmentation methods which rely mainly on the assumption that the neighbouring pixels within one region have similar values. The widespread procedure is to compare one pixel with its neighbours. If a similarity principle is satisfied, the pixel is set to belong to the cluster as one or more of its neighbours. The selection of the similarity criterion is important. There are two types in region growing, Seeded and Unseeded. The proposed system uses the first method. Seeded region growing method takes a set of seeds as input along with the image. The seeds mark each of the regions to be segmented. The regions are grown iteratively by comparing all the unallocated neighbouring pixels to the regions. Difference between the region's mean, δ, and intensity value of pixels is used as a measure of similarity. The pixel with the smallest difference measured in this way is assigned to the relevant region. The process continues until all pixels are assigned to a region. The new regions are then grown from the valleys. A faster approach [2] is used in the implementation:

- By averaging the local J values in the remaining unsegmented part of the region and connect pixels below the average to form growing areas. If a growing area is adjacent to one and only one valley, it is assigned to that valley.

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- Calculate local J values for the remaining pixels at the next smaller scale to more accurately locate the boundaries.
- Grow the remaining pixels one by one at the smallest scale. Unclassified pixels at the valley boundaries are stored in a buffer. Each time, the pixel with the minimum local J value is assigned to its neighbouring "valley" and the buffer is updated till all the pixels are classified.

D. Experimental Results

A real time satellite image from NASA is selected for performing segmentation. The image is subjected to various pre processing techniques such as RGB to gray, resizing and enhancement to derive the various features present in the image. The image in Figure 2 shows 720 x 360 size of a satellite Image of a rural scene. This image is applied to JSEG segmentation block which gives segmentation output with different scale values (number of bifurcation) is shown in Figure 3 to Figure 5. After performing similarity comparison of feature database and feature vector of query image, we obtain the final image which is similar to that of original image shown in Figure 6.

Figure 2: Original Image

Figure 3: JSEG output with scale 4

Figure 4: JSEG output with scale 18

Figure 5: JSEG output with scale 61

IV. CONCLUSIONS

The JSEG algorithm is tested on a real time satellite image. It can be seen that the image is segmented efficiently and the results are reasonable. The result is always depending on the nature of the image. The result of the image that contains homogenous colors is different from the image that contains inhomogeneous colors.

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