A New Multispectral Images Color Segmentation Algorithm Based On Rough-Set Approach and Region Merging

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Abstract

The paper presents the color image segmentation based on rough-set approach has been proposed. The color image segmentation is one of the most challenging tasks particularly in the area of image analysis, computer vision, and pattern recognition. In this paper, the proposed algorithm based on roughness index to calculate the peaks and valleys values. Based on peak and valley values to achieve better segmentation, Experimental results shows the roughness index theory to achieve better color image segmentation results and shows the graphs of roughness measurement versus intensities and compare to histogram and histon techniques.

Keywords:

roughness index theory, histogram and histon

I.INTRODUCTION

In segmentation, an image is partitioned into different non-overlapping homogeneous regions, where the homogeneity of a region may be composed based on different criteria such as gray level, color or texture. In many applications, the quality of final object classification and scene interpretation depends largely on the quality of the segmented output.

The Rough Set Theory (RST) was introduced by Pawlak as one of those techniques that can be used in determining potential success/failure of a particular business [1].Rough Sets Theory (RST) is a mathematical approach, proposed by Z. Pawlak in the early eighties and since has come into focus as an alternative to the more widely used method of machine learning and statistical data analysis [2], [3] and [4]. One of the most widely used techniques for image segmentation is the histogram-based thresholding, which assumes that homogeneous objects in the image manifest themselves as clusters. The advantage of such methods is that they do not need any a priori information of the image. In this method Adjacent pixels in an object are generally not independent of each other. To overcome this drawback used the histon, which is a contour plotted on the top of the histogram by considering a similar color sphere of a predefined radius around a pixel. The concept encapsulates the fundamentals of color image segmentation in a rough-set theoretic sense. For segmentation, only the upper approximation is considered and the histogram-based segmentation technique is applied on the histon to find the different regions in the image. The method does not take into account the lower approximation for segmentation and thus fails to utilize the properties of the boundary region between the two approximations in segmentation.

In this paper is organized as follows. The Rough-set approach technique is presented in Section II. Section III describes the segmentation. The simulation results are presented in SectionVI. Concluding remarks are made in Section V.

II. Rough-set approach technique

Based on rough-set approach to calculate the valleys and peaks values. Based on those values to find the better segmentation. The block diagram of rough-set approach as shown fig.1.

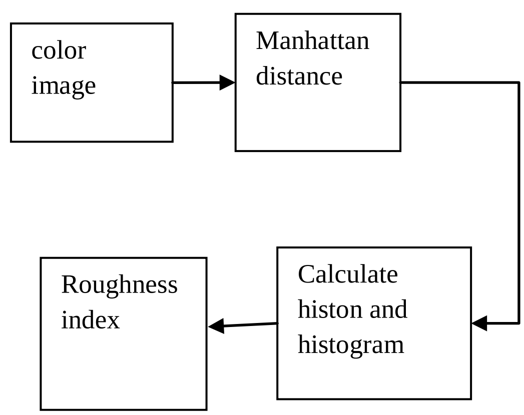

Fig.1.Procedure for roughness index

In Fig.1. Roughness index can contain four steps

In step 1, let us assume I to be color image contain three primary components, red R, green G, and blue B.

a. Manhattan distance

The Manhattan distance of the RGB color image can be computed as follows

Manuscript received September 5, 2014
Manuscript revised September 20, 2014

$$Dist = \sum(|R(m,n) + R(p,q)| + |G(m,n) + G(p,q)| + |B(m,n) + B(p,q)|)$$

Where

R(p,q) = neighborhood pixel of pixel R(m,n) in red color component

The total distance of all the pixels in the neighborhood and the current pixel I(m,n) is then given by

$$D_T = \sum\sum(Dist)$$

After that We define a matrix X of the size M × N such that an element X(m,n) is given by

$$X(m,n) = \begin{cases} 1 & d_T(m,n) < \text{expanse} \\ 0 & \text{otherwise} \end{cases}$$

b. Histon and histogram

Using **hist** command in MATLAB to calculate the histogram.The main advantage of histogram is that do not any a priory information of the image.

After that to calculate histon as shown below.

$$H_i(g) = \sum\sum [1+X(m,n,i)]\delta[I(m,n)-g]$$

Histon is basically a contour plotted on the top of existing histograms of the primary color components red, green and blue in such a manner that the collection of all points falling under the similar color sphere of the predefined radius, called expanse, belong to one single value.

Where

i=R,G and blue

c. Roughness index

Based on histon and histogram to calculate the roughness index as shown below

$\rho_i(g) = 1 - |h_i(g)|/|H_i(g)$ for $0 \le g \le L-1$

Here

$h_i(g)$=histogram of color image

$H_i(g)$=histon of color image

The value of roughness is large when the value of histon is large in comparison with the value of histogram. This situation typically occurs in the object region where there is very little variation in the pixel intensities. The variation in pixel intensities is always more near the boundary between the two objects. This situation will lead to a small (i.e. close to 0) value of roughness.

Based on roughness index to find out the peaks and valley values as shown in section IV.

III.SEGMENTATION

The segmentation process is divided into three stages. They are

i) The histogram and the histon of the R, G, and B components of the image are computed as explained in II.

ii) selection of peaks and threshold values

iii) Region merging

1) Region merging

Region merging is the third stage in the process of segmentation. Obtaining clusters on the basis of peaks and valleys usually results in over-segmentation. Many small regions are generated and some of the regions may contain very few pixels. Such small regions must be merged with the closest large regions. We have used the algorithm proposed by Cheng et al. (2002) for region merging. Using this algorithm, region merging is carried out in the following two steps:

1. The clusters with pixels less than some predefined threshold are merged with the nearest clusters. The process is repeated until the number of pixels in each cluster is greater than the threshold. Experimentally we found that threshold 0.1% of the total number of pixels in the image is appropriate.

2. Two closest regions, based on predefined distance between two clusters, are combined to form a single region. The process is repeated until the distance between any two regions in the image is greater than the predefined distance. Here also, experimentally we find that distance of 20 is appropriate threshold for region merging.

IV.SIMULATION RESULTS

From the results, we observe that the different regions in the images are well segmented where the colors of the segmented regions match with those in the original image and all the important details in the images are preserved.

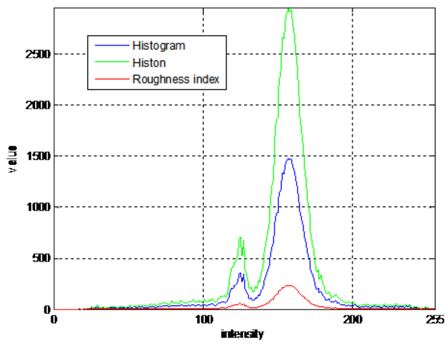

Fig.3. roughness index plot for 'red' component

In Fig.3. Shows the peaks occur at intensities in the graph of roughness index are 120 .140, 170 and valley values are 125,150,180. Which roughness is the maximum, the colors of the segmented regions are more close to the actual colors in the original image. This peaks and values represent in red component.

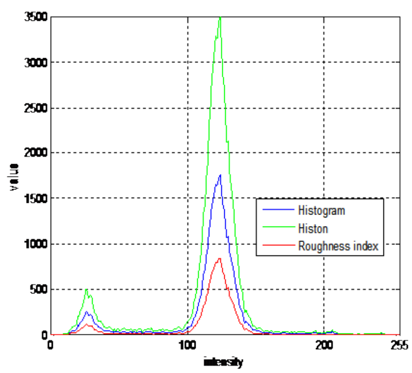

Fig.4. roughness index plot for 'Green' component

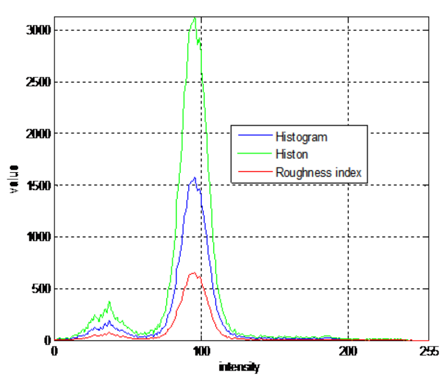

Fig.5. roughness index plot for 'Blue' component

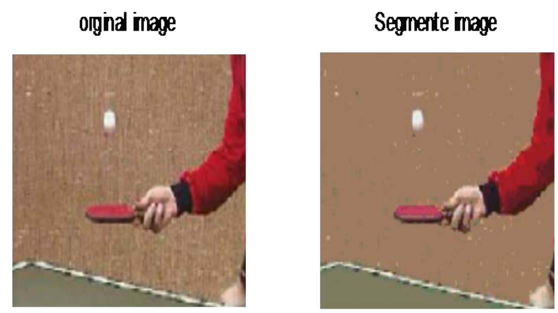

Fig.6. First row, first colom represent the 'table tennis image and first row, second colom represents the result of proposed segmentation method

V.CONCLUSION

We have presented a rough-set theoretic approach for color image segmentation. The proposed algorithm is a variant of the histogram-based segmentation algorithm in which the graph of roughness measure verses intensity values has been used as the basis of segmentation. The computational complexity of the proposed method is slightly more than the conventional histogram-based thresholding algorithm, but the key point of our approach is that, using the roughness index for selection of peaks and valleys results in more realistic values and thus achieves better segmentation results. The experimental results show the superiority of the algorithm. The proposed approach may have many image processing applications and can be easily extended for the segmentation of multispectral images. The proposed approach may still be refined using intuitionistic fuzzy sets and will be reported in future.

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