Image Segmentation using Entropy: A Review

Amanjot Kaur, Sukhwinder Bir, Harjasdeep Singh

Abstract— The main objective of Image Segmentation is to partition an image into different parts. Image segmentation basically used to detect the edges and boundaries. This is done to simplify and/or change the representation of an image in a more meaningful and easier way. Many image segmentation techniques are available in the literature. Some of them used gray level histograms, some used spatial and some used thresholding techniques. Under thresholding techniques there are different methods. One of those methods is entropy. Entropy is a measure of unpredictability. A good segmentation will be one that maximize the uniformity of pixels within the regions and minimize the uniformity across the regions. So we can say that entropy is a natural characteristic to be incorporated in evaluation function. This paper attempts to provide a brief review for image segmentation using entropy.

Index Terms—2D and 3D images, entropy, image segmentation, thresholding.

I. INTRODUCTION

Thresholding is simplest technique in image segmentation for gray scale and binary images. Different methods are used for thresholding to segment a particular image. Under these methods Histogram method is used to produce smoother histograms to partition the image. Using clustering method, the image is segmented into foreground and background clusters, and modeled using Gaussian. Edge attribute method finds the similarities in gray level and binary images. Spatial method used the high order probability distribution correlation. Entropy based methods used the entropy for foreground and background regions. Entropy based image segmentation approach is applied to color images as well as gray scale images from different sources. This paper review different ways applied on images using entropy method. We categorized this paper as first part gives introduction about the method. In second part background from some papers will be discussed using entropy method. Next part will give some techniques used for this method in various papers. Then further there is conclusion for the method.

II. BACKGROUND

Andre L. Barbier et. al [1] introduced an entropy based image segmentation approach and applied to color images obtained from Google earth, in order to identify aquatic, urban and rural regions.

This entropy approach has two main advantages i.e. (i) it is easy to implement and (ii) it's based on the entropy of the texture of an image.

This procedure generated three set of three different histograms for Red, Green and Blue colors. Authors have compared their methodology with two other methods of image segmentation- ColorMRF and Trainable Segmented Method, which evaluated the precision and verified with good results.

Bardera et. al [2] presented information-theoretic approach for thresholding based segmentation that used excess entropy for the structural information of a 2D and 3D image to locate optimal threshold. Excess entropy is a measure of global correlation or structure for spatial system in any dimension. This approach was assumed to apply on medical images that were structured in regions i.e. tissues or organs. Excess entropy overcomes the problem such as high dimensionality, spatially and non invariance to rotation appeared. In this method selection of threshold was formulated as a histogram quantization problem using the maximization of excess entropy.

Samy et. al proposed an approach for image segmentation via fuzzification of Renyi entropy of generalized distribution[3]. This approach measured the structure information of image and located the optimal threshold. In this approach different histograms were initiated. These histograms described foregrounds and backgrounds. This process allowed judging the quality of segmentation result. And this method also successfully extended and adapted the concept of entropy via fuzzification for segmented color and gray scale images.

Another method proposed by Sushil Kumar et. al [4] was based on differential evolution. This method was proposed for image thresholding. In this method differential evolution is embedded in the 2D maximum entropy method to obtain the optimized threshold. Main drawback of this method was that its computational time was too high.

Lijie Liu et. al [5] described segmentation algorithm for document images represented in block based multiscale pyramid. Image block were categorised based on their entropy values of the intensity histogram. This paper discussed two methods offline and online training to estimate model parameters, which were assumed to have Gaussian probability density function. Scanned document images were not discussed in this paper. There was also need to consider practical issues such as noise and low pass filtering distortion.

Magdolha Apro et. al [6], gave an idea for a permanent quality control of folding process in image segmentation. In this work maximum entropy was calculated for five color spaces, for 1D histogram. Maximum entropy considered the image foreground and background signal sources.

III. TECHNOLOGY USED

Andre L. Barbier et. al [1] grouped different image into windows with a particular size. Then entropy was calculated for each window.

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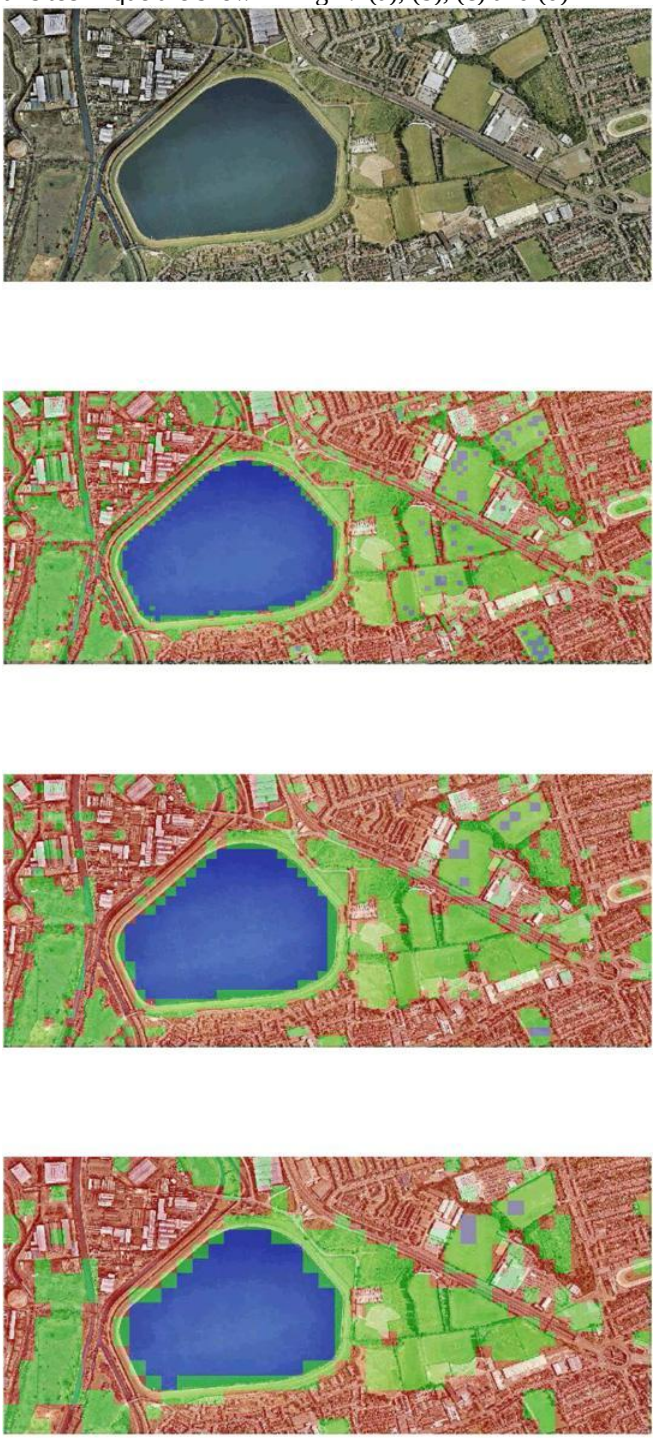
After that a classification technique was applied on each window. At last results were prepared from these classification methods applied on windows. Results using this technique are shown in fig 1.1(a), (b), (c) and (d)



(a)(b)(c)(d)

Fig. 1.1 A region and its respective segmentation by taking into account windows of size (a) 16, (b) 30 and (c) 46.

In [2] image histogram was calculated for the input image for a given length. Then excess entropy was calculated for the segmented image for given iterations at last gradient algorithm was applied to this threshold location.

[3] Technique overcome the noise in the image and shortens the image for storage. To reduce noise in image Gaussian smoothing was performed. After driving probability distribution for foreground and background entropy was calculated. One result by using this method is shown in fig. 1.2 (a), (b) and (c)

(a) Source Image

(b) Segmentation with Gray scale Histogram

(c) Segmentation with Color Space

Fig. 1.2 Fuzzy entropic segmentation for color image of a hand with a skin-like color distribution around

With the help of 2D entropy [4] the objective function was constructed and it was optimized with differential evolution to capture the entropy value. This method was applied on a set of different gray level images to get the required output.

[6] Processed different images with the help of segmentation algorithm. These binary images were compared to generate images from all measures. Then different test methods were applied on these images to obtain the results.

IV. CONCLUSION

This paper discussed different methods for image segmentation using entropy. Each and every method has some advantages and some future work to be done in the particular area. Some paper results are shown and others are discussed. As noted, in most of the methods noisy images or darken background image was the area that still not done. So in conclusion this can be said that more work is to be carried out in this field. One can improve the noise in the image or detect the edges more sharply by using entropy.

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