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A Survey on Grab-cut based Image Segmentation Techniques

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ABSTRACT

In Digital image processing the image Segmentation process plays a vital role to classify different areas in an image There are different kinds of Image Segmentation techniques such as Edge-based, Region-based, Threshold-based, GrabCut based to name a few. In this paper, a comparative study is done on different GrabCut based Image Segmentation Techniques such as (a). CIE color spaces, (b). Deep Convolutional Neural Networks, (c). Local Prior Distribution, (d). Superpixel, and (e). Bayes classification and Simple Linear Iterative Clustering. The scope of this paper is to study, analyze, and list the merits and demerits of these techniques. It will open up more research areas in this topic for better Image Segmentation results.

Key words : Bayes classification, Deep Convolutinal Neural Network, Grabcut, Local Prior Distribution, Simple Linear Iterative Clustering, Superpixel.

1.INTRODUCTION

Image segmentation is a key tasks in image processing, which is used to group image pixels into meaningful segments[3]. An image has a foreground region and a background region. The segmentation usually will separate these regions from one another. The segmentation based on the user involvement they are divided in to two separate classes such as Automatic Segmentation and Semi-automatic segmentation[4]. Automatic segmentation is the process whereby segment boundaries are assigned automatically by a program. Semi-automatic segmentation is the process whereby this automatic segmentation is followed by manual checking and editing of the segment boundaries.
GrabCut is kind of semi-automatic approach based on graph theory[13]. Compared to the graph cut, the segmentation results of GrabCut algorithm is much more better with minimal user interaction . In recent years, the GrabCut[12] interactive segmentation method has gained popularity due to its high success and ease of use. In this paper, we proposed a comparative study of different grab cut based image segmentation techniques.

2.LITERATURE SURVEY

In this section, the different improved grab cut based image segmentation algorithms are discussed.

2.1 CIE Color Space

The CIE color space was created to figure out different colors that can be visualized by the human eye. Different versions of CIE color space has been introduced . In paper[1], the result of using other color spaces such as RGB, HSV, YCbCr, and CIE color space, CIECAM02, CIECAM16 and JzAzBz[14] without changing the main steps Grabcut algorithm the different color spaces are used as input and it is analyzed. The image data set VGG used for testing with each color space .The experimental results gives, it has a positive effect on the Grabcut method. The images in the data set have been taken for the segmentation results. From these color spaces, CIECAM16 achieved a high success rate in accuracy, sensitivity, and precision specificity. From other color spaces image segmentation results obtained, the excess and deficiencies are mostly.

2.2 Deep Convolutional neural networks

Deep Convolutional neural networks(DCNN)[15] is a same model of CNN with a more complex structure. In recent years, a great improvement has been occurred in computer vision systems such as high-level problems including image classification[6], fine-grained categorization [8] , and object detection [7], In this paper[2] they suggested a pre-trained deep convolutional neural network (DCNN) model which can be interacted with GrabCut rather than real user. The DCNN should perform a specific task which includes the foreground object in the image which is taken as the input and calculating the closest position of the foreground,while interacting with the Grabcut Algorithm. Without real user interaction the algorithm has a one-to-one model . GrabCut as user, perform the following: (a) In the given input image finding its foreground object and (b) trimap initialization. The result of the GrabCut algorithm is known as trimap. Trimap initialization means the user draw a rectangle throughout the foreground object as shown in figure 1.

Figure 1: Trimap Initialization

The dataset used for segmentation is WSED [9]. This database which contain 100 images with foreground objects that differ in terms of intensity, texture,etc from their surroundings. The results are accesses by evaluating the consistency of their segmentation results.The F measure is used for calculating the consistency. The performance of the algorithm for the WSED dataset was good.The proposed method here is only applied to the figure-ground segmentation[10].This method is also applicable different object segmentation.

2.3 Local Prior Distribution

One of the most important approach in image segmentation is Grab cut algorithm . It improves the result in segmentation and finds more friendly for user interaction but the computational time on the segmentation is too long. In paper[4] a modified Grab cut based on Local prior distribution is proposed.. This approach shows better performance and segmentation results. The local prior distribution is used to improve the energy function to obtain better results than traditional ones. In this algorithm for the segmentation between the foreground and background need to add some prior information according to the prior distribution. The prior distribution is constructed by the user. The part of segmentation should be selected a premise and do not add other information. The pixel information included in the part of the segmentation object will be taken as the foreground model and the rest of the pixel in the dataset is taken as the background model. The experimental results shows that the proposed approach better performance and result in image segmentation than traditional Grab cut.

2.4 Superpixel

The Superpixel give a best way to calculate image features[11]. The complexity will be reduced , while there is any redundancy in the images features . The foreground color is similar to back ground color there will be a bad quality of the output image and there will be an excessive time complexity while interacting with the Grabcut Algorithm.To control the the time complexity the Grabcut method based on superpixel[3] has been introduced .This method will improve the segmentation performance and speed of the algorithm. This method will be extracting the superpixel block of the picture as shown in figure 2. Then the extracted picture is splitted. The results show that the proposed method is this paper[3] is highly efficient for improving the speed of the segmentation.

Figure 2: Extract Superpixel

This method is also practical for to solve the condition while foreground object color is similar to the background color in a certain extent which is shown in figure 3(a), and 3(b). The image from the superpixel block is extracted, the same color block will be fixed with superpixel. The main difference between the foreground object color and the background color will increases. The similarity between both foreground and background decreases, so the segmentation effect can be improved.

(a) (b)

Figure 3: Image who has similar foreground and Background

a) Original Image b)Segmented image

2.5 Bayes classification and Simple Linear Iterative Clustering

In Computer vision ,it is highly a challenging task to extract the foreground object in a complex background . It is also difficult to find color features, texture features ,and regional characteristics of the image while extracting the foreground objects . Information contained in the images having unpredictable complexity ,lack in precision, time-consuming and poor efficiency. In order to solve the segmentation problem this paper[5] proposed a GrabCut method based on color image segmentation has been introduced . The method combines Bayes classification[17] with simple linear iterative clustering (SLIC)[16] and then use the GrabCut method to obtain the foreground segmentation. SLIC method is used for automatic segmentation of color images,and fast clustering speed , the location edges are smooth. Minimum-error Bayes classification used to reduce the error rate in the image segmentation. The proposed method is applicable for single foreground object in a single background, Single foreground object in the complex background and multiple foreground objects in a complex background image as shown in figure 4.

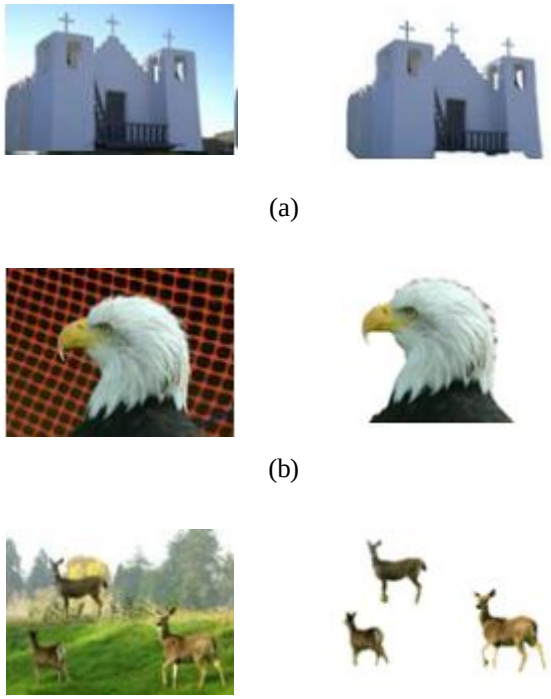

Figure 4: Segmentation results of the proposed method.

a) Single foreground object in a single background. b) Single foreground object in complex background. c)multiple foreground objects in the complex background.

3.COMPARISON

This section discusses the comparative study of different methods used in Grab cut image segmentation. Table 1 shows the advantages and disadvantages of these methods.

Sl No	Method	Advantages	Disadvantages
1	CIE Color Space	1. Consistent and Superior performance. 2. More efficient than other color spaces.	1. To extract the foreground from complex images is limited.
2	DCNN	1. Fully Automatic Segmentation. 2. Good Performance.	1. Not able to extract images contain the same two or more foreground objects. 2. Not able to extract the image containing different foreground objects.
3	Local prior Distribution	1. Better Performance. 2. Highly efficient than traditional GrabCut	1. Computational time is limited for some images. 2. Not able to resolve over-segmentation. 3. Automatic segmentation is limited
4	Superpixel	1. Highly efficient 2. Fast Segmentation 3. Able to extract the images whose foreground is similar to Background.	1. A more complex background does not have a perfect solution.
5	Bayes classification and SLIC	1. The Error rate is lower 2. Processing speed is lower 3. Able to extract the foreground in a complex background. 4. Able to extract multiple target foreground images in a complex background.	1. Resolve over-segmentation is limited.

Table 1: Comparison of different grab cut image segmentation Techniques

4.CONCLUSION

Extracting the foreground from the images is a difficult task. The grab cut algorithm is most popular for image segmentation. There are many shortcomings in Grab cut algorithm such as computational time, performance, efficiency which should be improved. The different GrabCut techniques discussed in this comparative study brings improvements on the above mentioned characteristics. Complex images in different applications needs to use these kinds of different techniques based their features.

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