Image Segmentation

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***Abstract*—In this assignment we use various techniques to segment images, the quality of the segmentation is then evaluated using the dice coefficient.**

I. Introduction

Image Segmentation is the process by which a digital image is partitioned into various subgroups (of pixels) called Image Objects, which can reduce the complexity of the image, and thus analysing the image becomes simpler. In this case we try to segment the pixels into two distinct groups, foreground and background.
To accomplish this task, we try various approaches such as Graph Cuts, Spectral Clustering and Super Pixels Methods.
We will then analyse the performance of each of these methods before selecting the best segmentation of the given images.

Fig. 1. Yolo_v3 Object Detector

II. Models

These are the following methods and models used for the task of image segmentation.

A. CNN based object detector in conjunction with Graph Cuts

The Graph Cut algorithm requires a foreground and background model in order to segment the image, however inorder to generate these models, we usually require user input to highlight the foreground. Thus, to workaround this issue, I used a CNN based object detector to detect the object which is assumed to be in the foreground, and I passed the bounding box of this object to the Graph Cut Algorithm. I used the cv2.GrabCut() API to apply the Graph Cuts algorithm. I

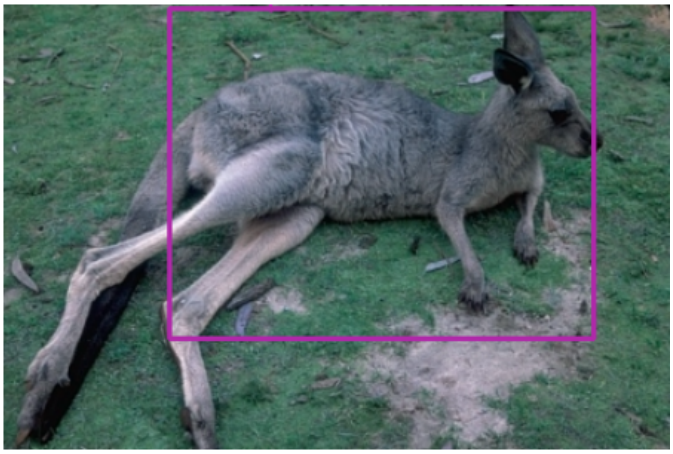

Fig. 2. FasterRCNN_ResNet50 Object Detector

tried using two different CNN based object detectors namely FasterRcnn_Resnet50 and Yolo_v3. Both the models worked well on the first image and were able to detect the object perfectly, and in conjunction with the Graph Cut Algorithm were able to produce a dice score of 0.964.

Fig. 3. Bad quality segmentation due to bad bounding box around the foreground. (FasterRCNN_ResNet50)

In the case of the second image, the FasterRcnn_Resnet50 model was not able to detect the object completely and hence resulted in poor performance of the Graph Cut algorithm as well.

The Yolo_v3 model however was able to detect the object well and hence provided a good bounding box to the Graph Cut Algorithm. Both these models could not detect the object in the image, thus I was unable to use the Graph Cuts Algorithm on this image for segmentation.

B. Super Pixel Method

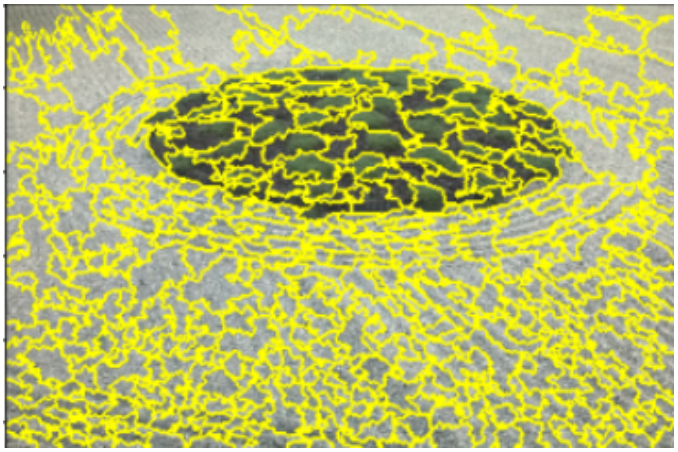

Fig. 4. Super Pixel Method with Scale = 100

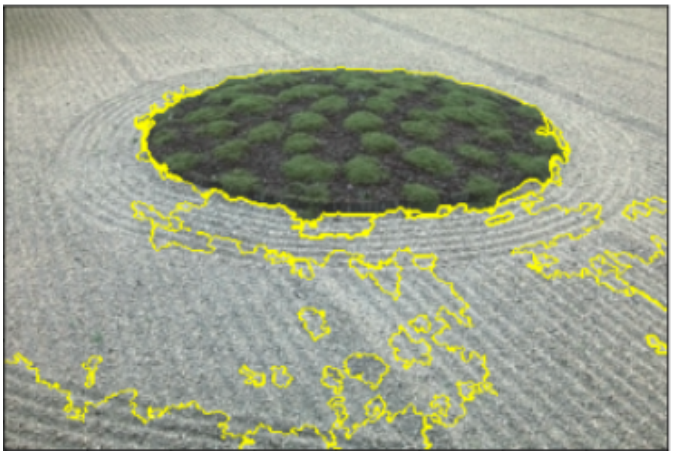

Fig. 5. Super Pixel Method with Scale = 500

I tried using Felzenszwalb's segmentation algorithm to segment the image, here increasing the scale parameter reduces the number of segments in the image, although large scale values resulted in 2-3 segments, I found that the quality of the segmentation was bad in the first two images, however it segmented the last image into 3 segments, where 2 of the labels represented the background and foreground very well and a very small number of pixels were given the other label.

C. Spectral Clustering

The spectral clustering algorithm like the super pixel method produced good results on the last image, however this algorithm was able to generate good results only when the image was downsized, approx (30 x 30), larger sizes of the image resulted in a reduction in the quality of segmentation, and hence the the segmentation appears blurred and not very accurate.

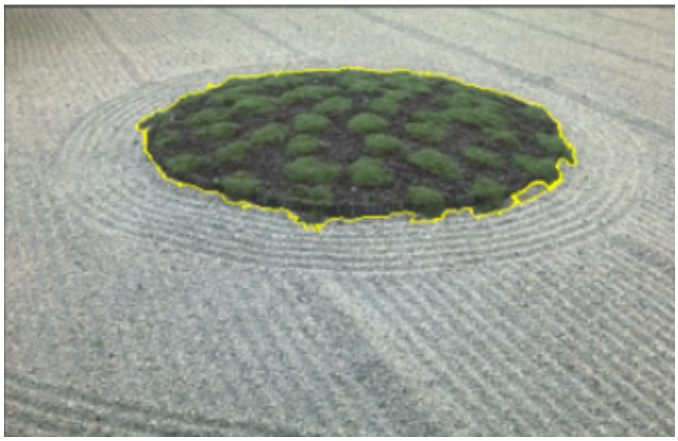

Fig. 6. Super Pixel Method with Scale = 2000

Fig. 7. Blurred segmentation when using spectral clustering

III. Final Segmented Images

I used the Yolo_v3 model in conjunction with the grab cut method to generate the segmented images for the first 2 images. For the first image, both the models produced the same dice score of 0.96, however in the case of the second image the Faster_RCNN model was not able to detect the kangaroo correctly and thus made it hard to generate good background and foreground models. For the 3rd image, I used the Super Pixel Method to segment the image as it generated a highly accurate segmentation at a scale value of 2000.

IV. Acknowledgement

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