Term Project Report

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Video Demo: https://www.youtube.com/playlist?list=PL6Dk74LMjctUlnr4VHbMkOCdUNSd-X5ZZ

Our term project highlights the basics of image segmentation that we learned this semester.

We start by demonstrating the K means clustering. K-means clustering algorithm is used to separate the area of interest from the background. In clusters, or partitions the given data is divided into K clusters of parts based on the K-centroids.

We start with a picture of a friend’s cat as shown below. Once the code is run, the following results are received:

A cat sitting on top of each other

Description automatically generated A picture containing animal, water, coral

Description automatically generatedA picture containing cat

Description automatically generated

As shown above, the first image is the original. The image shows the clusters in the form of different colours. The edges of the cat are clear, although we can also see some unwanted clusters formed on the floor. The third image is the grayscale version of the second.

To get rid of these limitations, we also tried a second image with a much cleaner background. The results are shown below:

A picture containing game, sport

Description automatically generatedA close up of a logo

Description automatically generatedA picture containing game, racket

Description automatically generated

Here we can notice the result images to be much cleaner due to the smooth background. It is very easy to distinguish the object from the background.

Next we move onto what is known as the mean shift. It is used for edge-preserving, smoothing or for segmentation. Important edges of an image might be easily detected after mean shift filtering.

How it works: for each pixel of an image, the set of neighboring pixels is determined. For this set of neighbor pixels, the new spacial mean and the new colour mean value are calculated. These calculated mean values will serve as the new centre for the next iteration. This keeps happening until the special and the colour stops changing.

We started with an image of a head and went from there. Our results are shown below:

A person looking at the camera

Description automatically generatedA close up of a person

Description automatically generatedA close up of a mans face

Description automatically generatedA person looking at the camera

Description automatically generated

The first is the original image. The second is the result of a total of 65 iterations of mean shifting. The third image show the edges of the image. Finally, the fourth shown the edges on top of the original image for better understanding.

To understand things better we ran the same code with the same image with different numbers of iteration. The results are shown below with four different numbers of iteration.

A person looking at the camera

Description automatically generatedA person looking at the camera

Description automatically generatedA person looking at the camera

Description automatically generatedA person looking at the camera

Description automatically generated

The first image is a result of 80 iterations. The second, 135, third, 155 and the last image is a result of 170 iterations. There are some differences in the results when it comes to details. All the images successfully outline the more important edges such as the head and houses. Around iteration 135 the algorithm focused more on the less contrasting edges. Hence, the tree wasn’t paid close attention to. In all the other images, the branches or the tree are very well defined.

Now we move onto label segmentation. Here we attempt to extract the objects from the image. We start will the following image and run our code. The result is as shown below:

A picture containing room

Description automatically generatedA picture containing wheel

Description automatically generatedA close up of a logo

Description automatically generatedA picture containing device, mirror

Description automatically generatedA picture containing mirror

Description automatically generatedA picture containing knife

Description automatically generatedA close up of a logo

Description automatically generatedA close up of a logo

Description automatically generatedA close up of a logo

Description automatically generatedA close up of a logo

Description automatically generatedA picture containing clock

Description automatically generatedA picture containing table

Description automatically generatedA close up of a logo

Description automatically generatedA close up of a logo

Description automatically generated

As we can see, each object is shown in a separate image. The items have been divided nicely because the borders were clear, and the objects were separated. This might not be the case for many other images. We will demonstrate this in a short video called “limitations of label segmentation”. The URL is provided on the top of the document.

Next we try to do a similar thing but here instead of making different figures with each object we will simply outline them. We used the same image as before, will 12 distinct objects. These were our results:

A picture containing room, refrigerator

Description automatically generatedA picture containing keyboard

Description automatically generated

We tried the same thing with a few more times with different thresholds. We tried 150 and 250. The results are shown below:

A picture containing food

Description automatically generatedA close up of a logo

Description automatically generated

In the first image when the threshold is set to 150, it picks up on some more details that might be wanted. The edges are very clean and sharp. When the threshold is increased to 250, the image is heavily blurred out, but the watermarks are more prominent. The outlines are nowhere as clean.