CSCI 631: Computer Vision
Homework 2

Aditi Anant Munjekar
am6180@rit.edu

1.
    - I have implemented texture-based segmentation and color based segmentation in this assignment. I found it interesting that more the clusters better is the result of segmentation. I was under the impression that since I have to segment background from the foreground only two clusters would be required: one for background and the other for foreground. But this does not happen practically.

    - The most interesting part about my implementation is the way how I have applied 48 filters to the same image and then converted this 3D images to a 2D image. Other thing which I found interesting is that, how differently kMeans algorithm reacts to different color schemes (RGB, HSV, LAB).

    - Kmeans has a hard time to determine the cluster centroids in case of messy data. The outliers in the data is normally distributed, too, and then the Kmeans algorithm is not able to determine which cluster the points belong to.

    - Another drawback of KMeans algorithm is that we have to determine the number of clusters before. To get the accurate results we have to perform trial and error, which is time consuming. The algorithm, is time-consuming for large number of data points since it has to keep on calculating the distances from every other point.

    - KMeans does not work well with clusters of different sizes, densities, and Non-globular shapes.

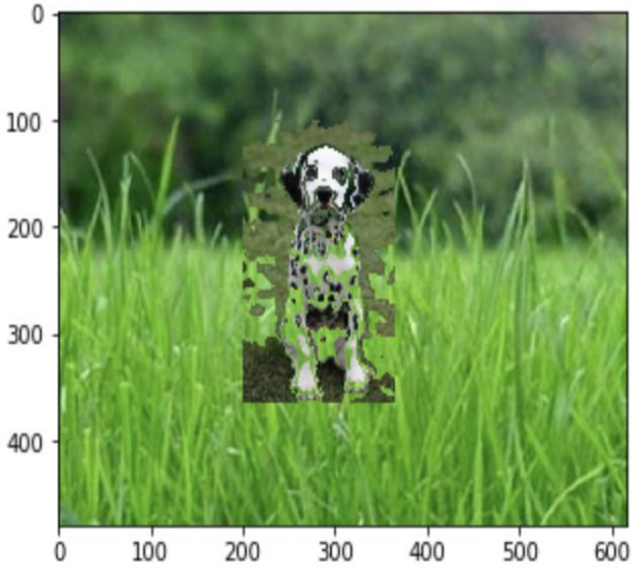
    - Having said this, I found that Kmeans algorithm is easy to implement and it works well with all natural images.

2. I **have implemented** my own version of KMeans algorithm.
   I have created a separate jupyter notebook for this - k-means algorithm.ipynb
   I have used the following websites for my reference:
    - http://madhugnadig.com/articles/machine-learning/2017/03/04/implementing-k-means-clustering-from-scratch-in-python.html
    - https://mubaris.com/posts/kmeans-clustering/

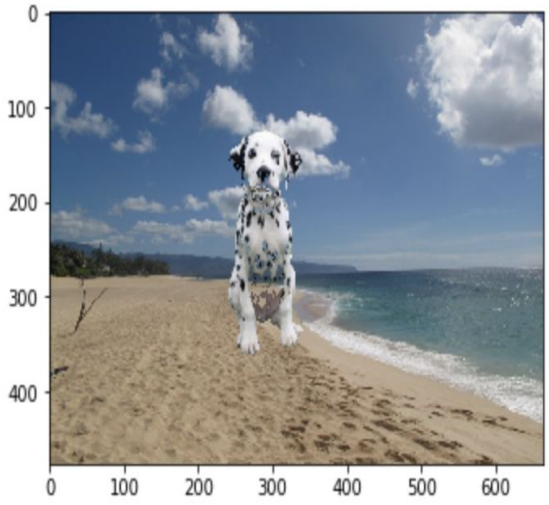
   The dataset used for demonstration is provided in the zip file.

3. ***Image 1: Dog***

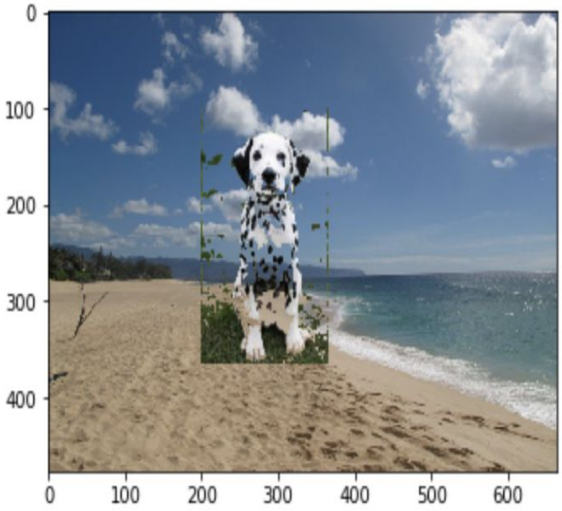
Original image



Texture-based segmentation

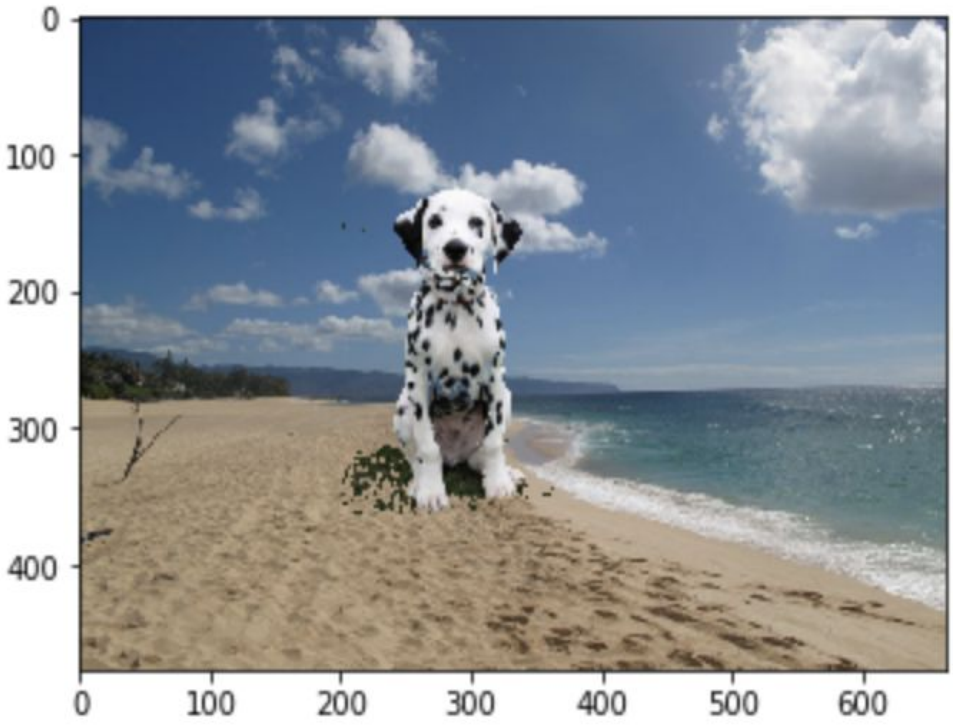


HSV color based segmentation



RGB color based segmentation

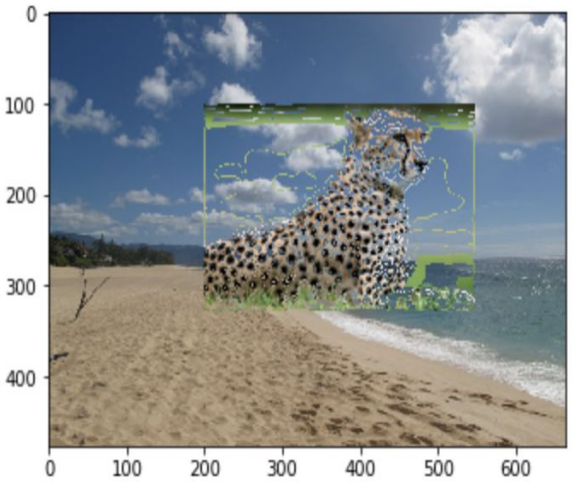
As can be seen from the above results, color based segmentations are giving better results than texture based segmentation. Among the three color-based, Lab color scheme gave the best result as can be seen below.



Lab color based segmentation

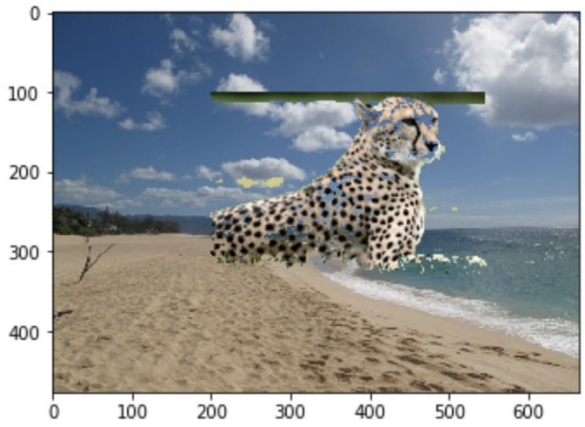
Image 2: Cheetah

Original image

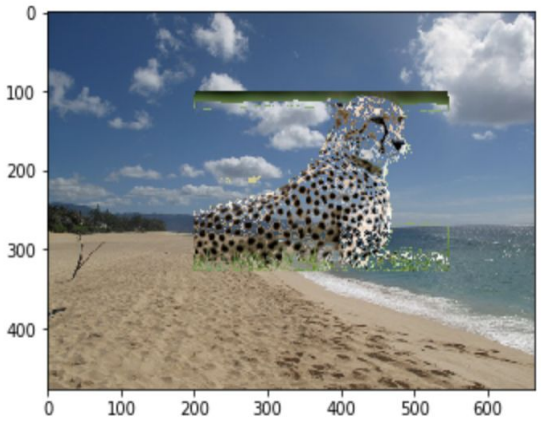


Texture based segmentation

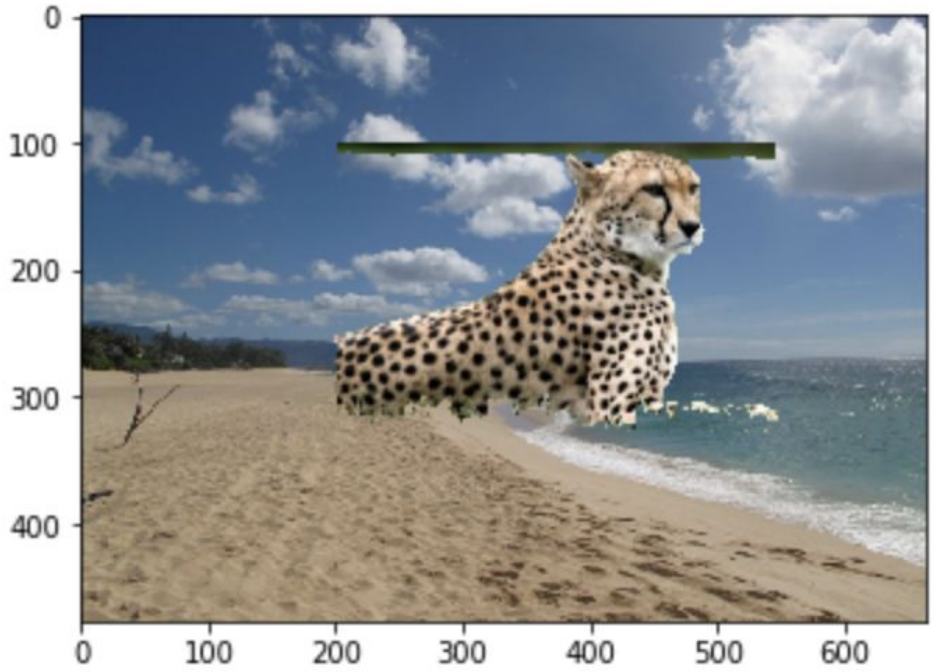
Just like for the dog image, the results of color based segmentation are much better than the texture based segmentation. The results of the color based segmentation are below. LAB based color segmentation, again, gave the best results.



HSV color based segmentation

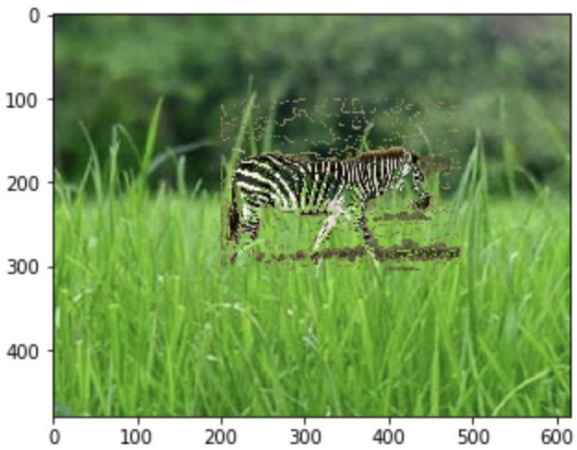


RGB color based segmentation

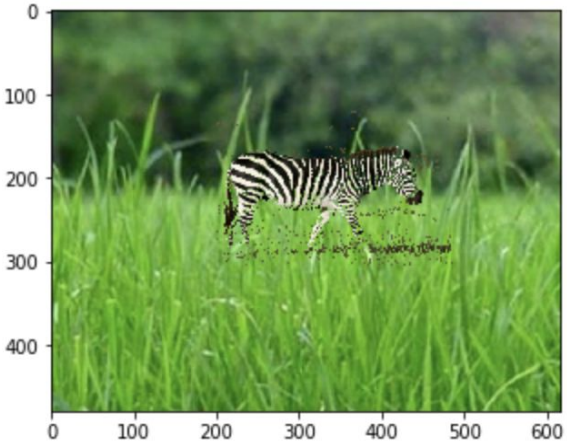


LAB based color segmentation

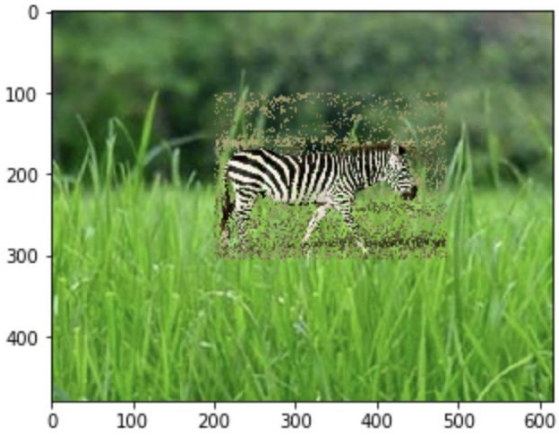
Image 3: Zebra



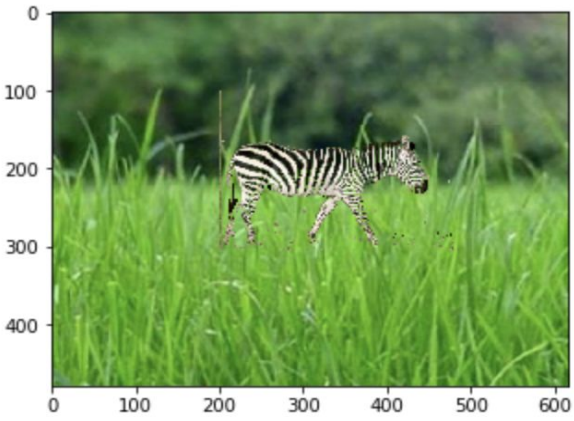
Texture based segmentation



HSV color based segmentation



RGB color based



LAB color based

The texture based segmentation is clearly not as good as color based segmentation. **Segmentation with Lab color** scheme, works best with all the three images. There is a lot of interference of the background while using the texture based segmentation.

4. KMeans clustering fails because of interference of noise and non globular shape of dataset. The result also depends on the type of distance metric used. Euclidean distance is not a very good metric for segmentation. As the value of k increases the clusters become more coarse and discrete.
   Also, with some low contrast image, accurate result could not be provided, like with the medical images. Hence, according to the paper, **Image Segmentation using K-means Clustering Algorithm and Subtractive Clustering Algorithm**, the algorithm proposed consists of partial contrast stretching, subtractive clustering, k-means clustering and median filter. Mostly the medical images which are used for segmentation have low contrast. So contrast stretching is used to improve the quality of the image. After improving the quality of image, subtractive clustering algorithm is used to generate the centers, based on the potential value of the image. Number of centre is generated based on number of cluster k. This centre is used as initial centre in k-means algorithm. Using

the k-means algorithm, the image is segmented into k number of cluster. After the segmentation of image, the image can still contain some unwanted region or noise. These noises are removed by using the median filter. This approach has worked better than applying the traditional k-means clustering algorithm.