EE769 Introduction to Machine Learning
Project : Image Segmentation

Vyomkesh Chaudhary| 203070028
Rishabh Kumar| 203190005
Ashish kumar Dubey| 203190007

Abstract

Image Segmentation is a process to find objects in a image, shape of the object and which pixel belongs to which object,etc.In our case we will segment the image .Each pixel of the image will get assigned to a given label.The, task of image segmentation is to train Neural network and from K-means Clustering. This would help us in having a understanding the image in a great detail ,ie, pixel level.

Few Applications of image segmentation are self driving cars , medical imaging and satellite imaging.

Introduction

1.Problem Statement: Partitioning of a image into multiple segments is known as Image segmentation.The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze.Segmentation is an important stage of the image recognition system because it extracts the objects of our interest, for further processing such as description or recognition. Segmentation of an image is in practice for the classification of image pixel. For example, this can be used in self driving cars where cars have to predict objects while making decisions.

2.Challenges: Implementation of Image Segmentation is quite complex with the help of tensorflow.High Accuracy is one important factor which is hard to get ,i.e. getting 95 to 100 percent accurracy is quite hard.

3.Salient Features: k-means algorithm is simple and easy to understand. We are assigning each pixels to each clusters which are closest to them.

The shape of that object, which pixel belongs to which object, etc.

Edge detection techniques have therefore been used as the base of segmentation technique.

Neural Network model is having approx 75 percent accuracy.

Background and previous work

1.Understanding beyond basic ML: Understanding of images,color ,i.e.,Pixels are organized as a x/y grid , and each pixel is a combination of three colors RGB.

Understanding of how tensorflow , opencv library works.

Understanding of Unet model .

2.Other Work done before: Mask RCNN is a deep neural network aimed to solve instance segmentation problem in machine learning or computer vision. In other words, it can separate different objects in a image or a video. You give it a image, it gives you the object bounding boxes, classes and masks.

Datasets

The Oxford-IIIT Pet Dataset: https://www.robots.ox.ac.uk/ vgg/data/pets/

There are 37 category pet dataset with roughly 200 images for each class. The images have a large variations in scale, pose and lighting. All images have an associated ground truth annotation of breed, head ROI, and pixel level trimap segmentation.
The dataset already contains the required splits of test and train .
I have to normalize the pixels in [0,1] and also rotate.

Procedure and Experiments

Steps for K-means:

1.Choosing k No of clusters
2.choosing k centroids i.e.,k random RGB values
3.Running this algo again and again
4.We can see there are clusters with dominant colors.

Steps for UNet model
The model being used here is a modified U-Net. A U-Net consists of an encoder (downsampler) and decoder (upsampler). In-order to learn robust features, and reduce the number of trainable parameters, a pretrained model can be used as the encoder. Thus, the encoder for this task will be a pretrained MobileNetV2 model, whose intermediate outputs will be used, and the decoder will be the upsample block already implemented in TensorFlow Examples in the Pix2pix tutorial.

[hbt!]

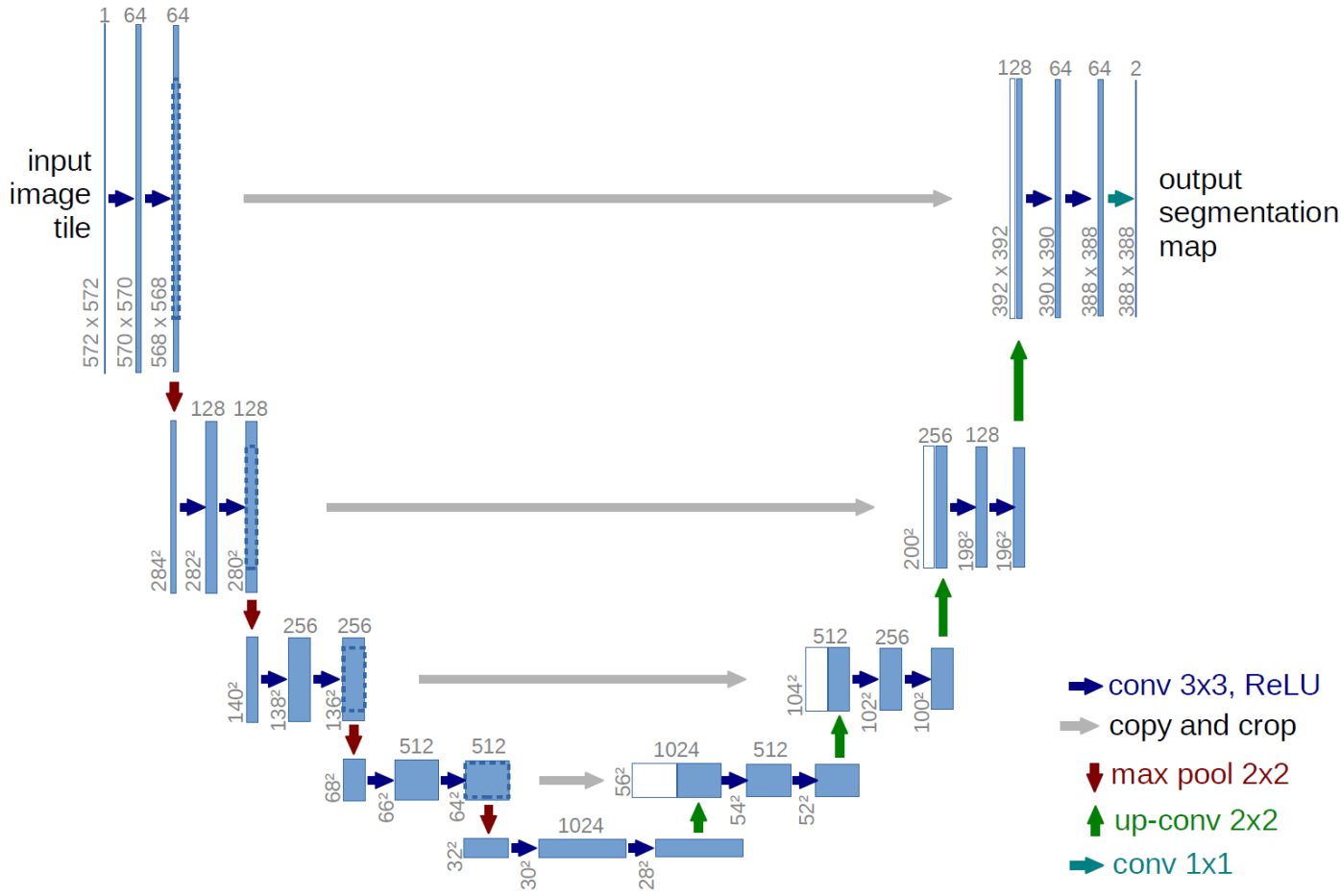

Figure 1: Source:U-Net: Convolutional Networks for Biomedical Image Segmentation https://lmb.informatik.uni-freiburg.de/people/ronneber/u-net/

Result

K-means:

Figure 2: Original image

Figure 3: Image After K-means clustering

For this Image we have taken k=6, i.e., 6 dominant colors are in this image.If we reduce the number of clusters than image quality is very poor. We can use this technique in image compression also where only dominant colors are retained.

UNet Model

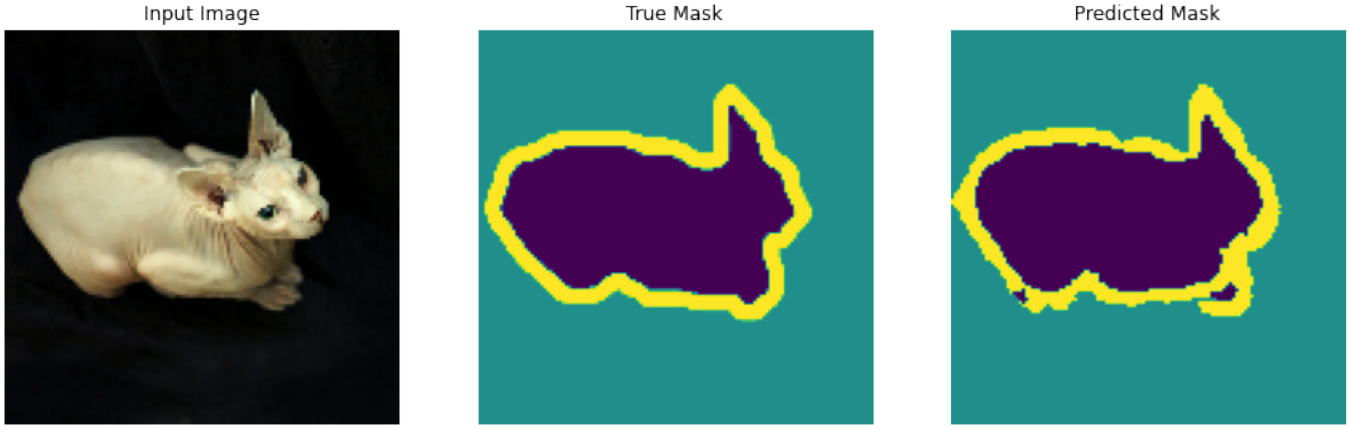

Figure 4: UNet Model

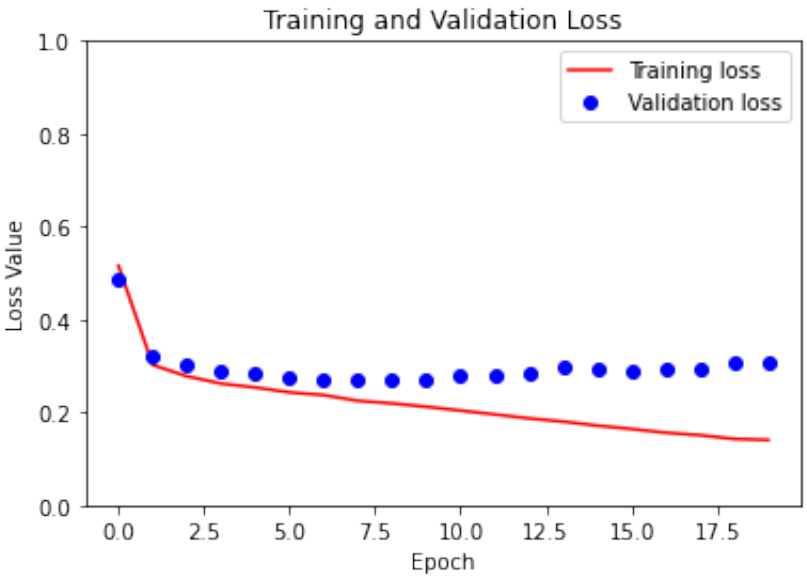

Figure 5: Training and Validation Loss

Validation loss is constant after 7 Epoch and training loss is also quite low.

Conclusions

1.If we consider less number of k then there are less segmentation and if we take more number of k then the image is segmented more and more. Hence the clarity is more in more number of k.
2.Training and validation in more number of Epochs giving good results .

Insights for further implication, application, or improvement

After segmentation we can detect which object is this or which shape/color is of this object.

We can use these techniques in automated cars where cars have to sense that which object is what , medical purposes i.e., dividing an image into areas based on a specified description, such as segmenting body organs/tissues in the medical applications for border detection, tumor detection.

Our accuracy is not that much great , so there is a scope of improvement in accuracy.

Statement of contributions

1.Vyomkesh Chaudhary(203070028): Have contributed in Project Conception , done Coding of Unet model and given inputs in k-means ,have written report using latex, have contributed in video.

2.Rishabh Kumar (203190005): Have Contributed in Project Conception , done coding of K means clustering and have inputs in Unet model also, collected data for report,have contributed in video.

3.Ashish Kumar Dubey (203190007): Have Contributed in Project Conception , data collection ,given inputs in both k means and Unet model,framed the language of the report ,have contributed in video.

References

1. Dataset: https://www.robots.ox.ac.uk/ vgg/data/pets/
2. https://www.tensorflow.org/tutorials/images/segmentation
3. https://github.com/tensorflow/examples
4. https://www.youtube.com/watch?v=nDPWywWRIRolist=WLindex=1t=184s
5. https://www.geeksforgeeks.org/image-segmentation-using-k-means-clustering/