COMPUTER VISION PROJECT REPORT
Image Segmentation
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ABSTRACT

Implementation of the Image segmentation on car images dataset using U-NET model

INTRODUCTION

Image segmentation is the process of partitioning a digital image into multiple segments. 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. Image segmentation is typically used to locate objects and boundaries in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

IMPLEMENTATION AND PAPER DETAILS

PAPER DESCRIPTION:

In this paper, model build upon a more elegant architecture, the so-called “fully convolutional network”. Where model is modified and extend the architecture such that it works with very few training images and yields more precise segmentations. The main idea in is to supplement a usual contracting network by successive layers, where pooling operators are replaced by up sampling operators. Hence, these layers increase the resolution of the output. In order to localize, high resolution features from the contracting path are combined with the up sampled.

Technologies Used:

Pytorch: For implementation of Convolutions

PIL: For Reading of the image

Numpy: For Matrix Operations

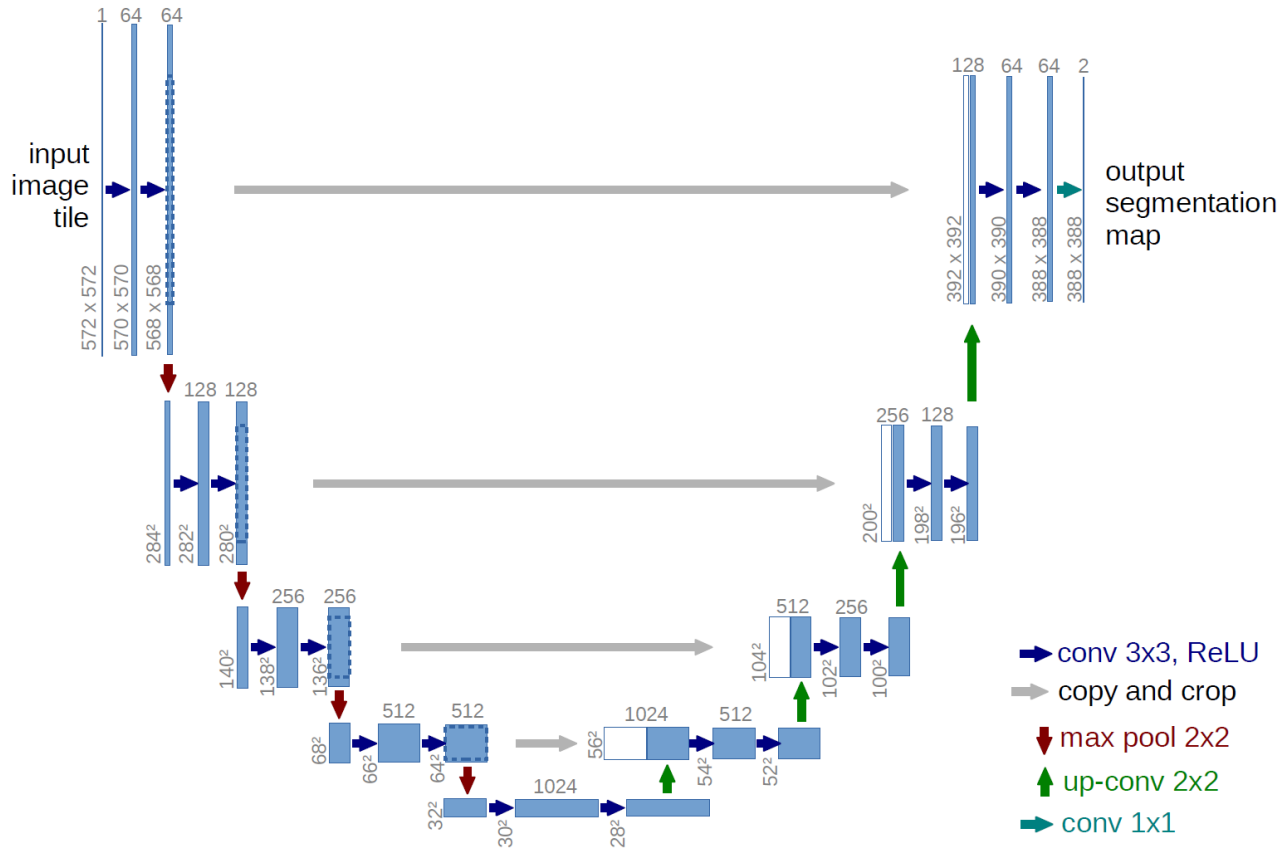
Albumentations: For resizing the image

Dataset: Dataset consists of 30 sections from a serial section Transmission Electron Microscopy dataset of the Ventral Nerve Cord (VNC)

Network Architecture:

The network architecture is U-Net. It consists of a contracting path (left side) and an expansive path (right side). The contracting path follows the typical architecture of a convolutional network. It consists of the repeated application of two 3x3 convolutions (unpadded convolutions), each followed by a rectified linear unit

(ReLU) and a 2x2 max pooling operation with stride 2 for downsampling. At each downsampling step we double the number of feature channels. Every step in the expansive path consists of an upsampling of the feature map followed by a 2x2 convolution (“up-convolution”) that halves the number of feature channels, a concatenation with the correspondingly cropped feature map from the contracting path, and two 3x3 convolutions, each followed by a ReLU. The cropping is necessary due to the loss of border pixels in every convolution. At the final layer a 1x1 convolution is used to map each 64-component feature vector to the desired number of classes. In total the network has 23 convolutional layers. To allow a seamless tiling of the output segmentation map, it is important to select the input tile size such that all 2x2 max-pooling operations are applied to a layer with an even x- and y-size.



PAPER IMPLEMENTATION DETAILS

In this Paper they used the Transmission Electron Microscopy dataset and trained the images on the U-net architecture and got and error of u-net Wrapping Error: 0.000353 Rand error:0.0382 Pixel Error: 0.0611.

PROJECT IMPLEMENTATION:

Dataset: The dataset used is CARVANA dataset which consists of 5088 samples of different car images.

Model:

U-NET architecture discussed in the paper is used to train the images.

Technologies Used:

Pytorch: For implementation of Convolutions

PIL: For Reading of the image

Numpy: For Matrix Operations

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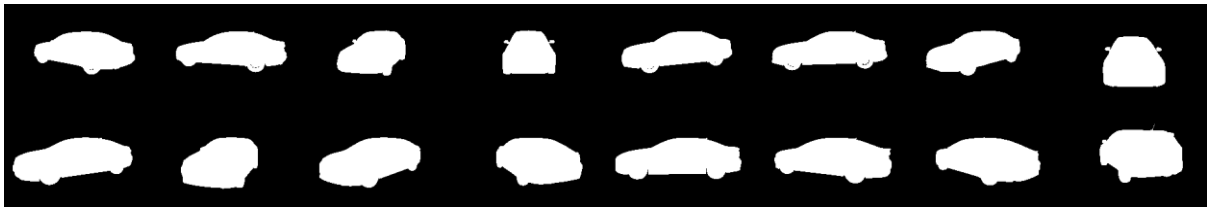
Training:

The samples are resized into 160x240 images and trained the U-Net model with three number of Epochs

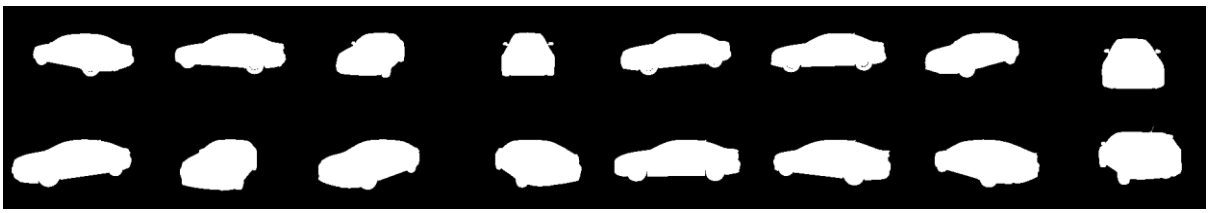
Result:

When tested with the validation set got and accuracy of 98.41% for the pixel comparison and a DICE score of 97.68%.

Actual Images:



Predicted Images:



Conclusion:

For implementation of U-Net the image segmentation score has been increase compared to the previous techniques and got a DICE score of 98%.

REFERENCES:

1. Ronneberger, Olaf, Philipp Fischer, and Thomas Brox. "U-net: Convolutional networks for biomedical image segmentation." International Conference on Medical image computing and computer-assisted intervention. Springer, Cham, 2015.

2. Chen, Liang-Chieh, et al. "Semantic image segmentation with deep convolutional nets and fully connected crfs." arXiv preprint arXiv:1412.7062 (2014).