

A Time-Lapse Photography System Based on 8-bit Quantized Style Transfer CNNs

Famous painters can paint many paintings of various styles. In order to make pictures look like painted by painters, images can be transferred to different styles by using the image transfer model. We are interested in the optimization and application of the image transfer network.

In this project, we first trained an image transfer network, and try to quantize the network to accelerate the speed of computing. After quantizing the network, we implemented the network on Raspberry Pi, and design an application of the network. Our application is a time-lapse photography system implemented in Raspberry Pi.

First, we train style transfer model by convolution neural network and using different style image to train and compare the effect of the models. Convolution neural network is based on network of Johnson's paper, *Perceptual Losses for Real-Time Style Transfer and Super-Resolution*. The whole network is including image transform network and loss network, and we want to train image transform network among them. Import white noise image to image transform net and put the result of the image transform network and style image and content image to the loss network, which is the pre-trained model vgg19. We calculate the loss by the method of Johnson's paper at loss network. In the training process, we use Gaussian approach to modify the weights of style transform network. Therefore, the totally loss would decrease and we can train the style transform model successfully. In this process, we all use 32bits to store the models' weights.

Next, we want to store the trained model with fewer bits, so we modified the function of convolution and trained the model to 4bits, 8bits and 16bits to test the performance of these models in actual conversion of pictures and the loss of training during training. The trend and the final convergence value, we found that the value of loss does not have much difference. However, observing the transferred picture, we will find that the more bits stored in the model, the more refined the result will be. The performance of the 4-bits model is not effective, but the conversion effect of 8bits and 16bits is similar to that of 32-bits.

In addition, we also moved the style conversion model to Raspberry Pi for execution and tested its performance. Although it took a long time to execute due to the lack of GPU, we also did a time-lapse photography application for raspberry pi. After

taking pictures, the raspberry pi camera directly performs style conversion on the board, takes pictures at a certain frequency and converts them, and finally converts them into videos using an image processing program. Finally, we completed an effective time-lapse photography.

Since the OS of Raspberry Pi still uses 32 bits to computing, there is no reduction of the execution time for transforming images. We think if the system of our project is implemented on FPGA, the effect of quantization will be more significant. Due to limited time, we didn't implement it on FPGA, but this may be our goal for optimizing our project.