ADVANCE IMAGE PROCESSING

FINAL PROJECT ON

NEURAL STYLE TRANSFER

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INTRODUCTION

- Neural Style Transfer is the technique of blending style from one image into another image keeping its content intact.
- The only change is the style configurations of the image to give an artistic touch to your image.
- The content image describes the layout or the sketch and the Style is the painting or the colours.
- Neural Style Transfer deals with two sets of images: Content image and Style image.
- This technique helps to recreate the content image in the style of the reference image.
- It uses Neural Networks to apply the artistic style from one image to another.
- Neural style transfer opens up endless possibilities in design content generation and the development of creative tools.

GRAM MATRIX

- The style of an image is captured by the correlations between the different filter responses. The feature correlations are given by the Gram Matrix $G_l \in R^{N_l X N_l}$, where G_{ij}^l the inner product between the vectorized feature maps i and j at layer l :-

$$G_{ij}^l = \sum_{i,j} F_{ik}^l F_{jk}^l$$

STYLE TRANSFER ALGORITHM

In deep learning, we normally optimize the parameters of some neural network. However, to transfer the style of an artwork a onto a photograph p, we repeatedly optimize the pixel values of the constructed image x, so that x simultaneously matches the style representation of a and the content representation of p. At the beginning, x is initialized to random noise. In order to get a good stylized output, x, we jointly minimize the content loss and the style loss. The final loss function we minimize is:-

$$L_{total}(p, a, x) = \alpha L_{content} + \beta L_{style}$$

$$L_{content}(\hat{o}, \hat{g}) = \sum_{l=0}^{L} c_l \, C_l(\hat{o}, \hat{g})$$

$$L_{style}(\hat{o}, \hat{g}) = \sum_{l=0}^{L} s_l S_l(\hat{o}, \hat{g})$$

$\mathcal{L}_{\text{content}}$ ( , ) ≈ 0

A schematic of the content loss.

$\mathcal{L}_{\text{style}}$ ( , ) ≈ 0

A schematic of the style loss.

EXPERIMENTATIONS DONE WITH ONE CONTENT AND ONE STYLE IMAGE

Content Image

Style Image

Manual

Generated Image

Generated Image

Library Function

Content Image

Style Image

Manual

Generated Image

Library Function

Generated Image

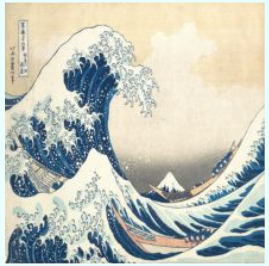
EXTENSION DONE BY TAKING 3 STYLE IMAGES ON ONE CONTENT IMAGE

Content Image

Style 1 Image

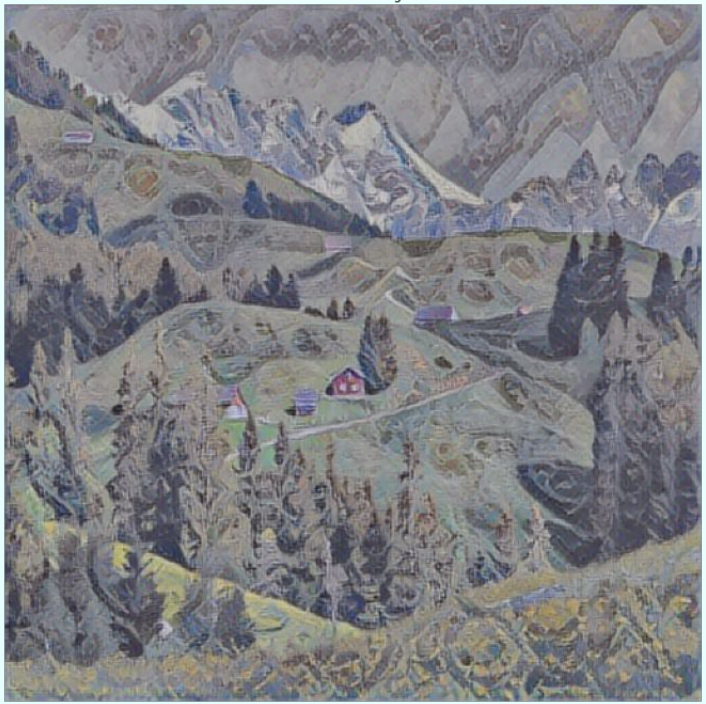
Style 2 Image

Style 3 Image



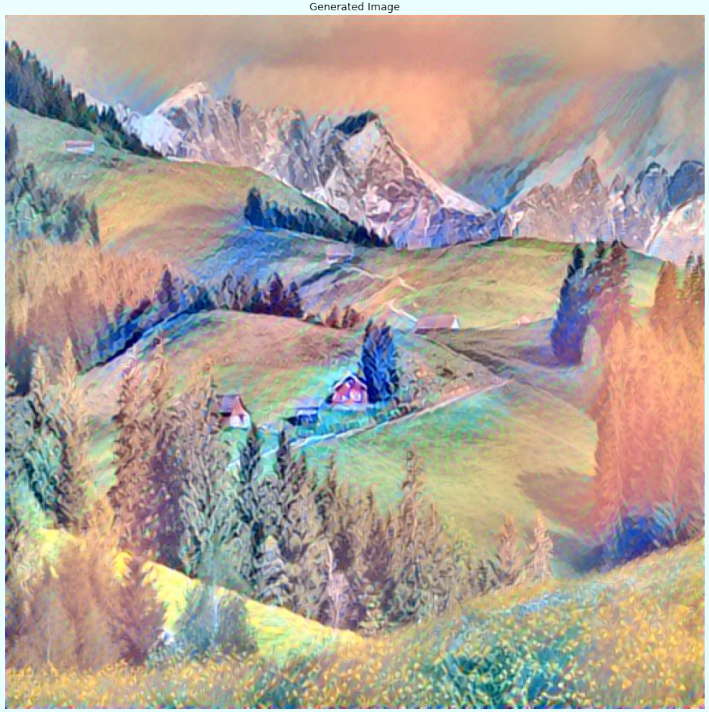
Library Function

Generated Image



Manual

Generated Image



Content Image

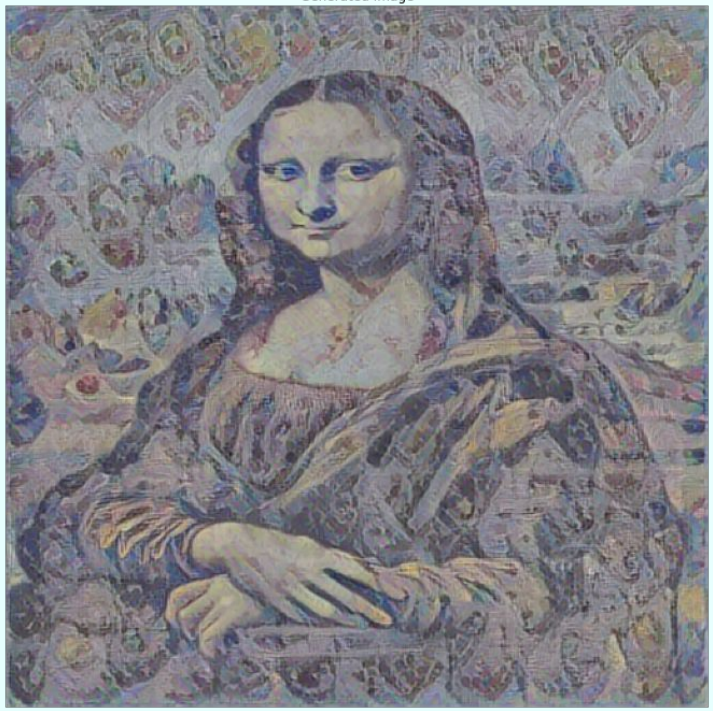
Style 1 Image

Style 2 Image

Style 3 Image

Library function

Generated Image



Generated Image

Manual

Content Image

Style 1 Image

Style 2 Image

Style 3 Image

Library Function

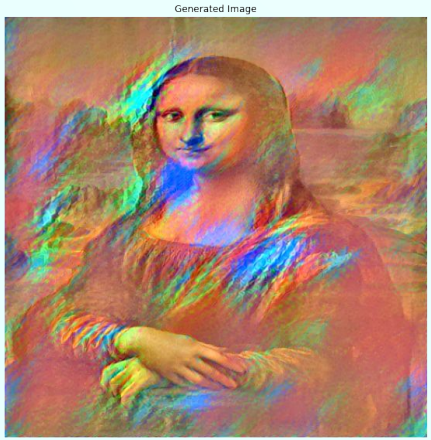
Generated Image

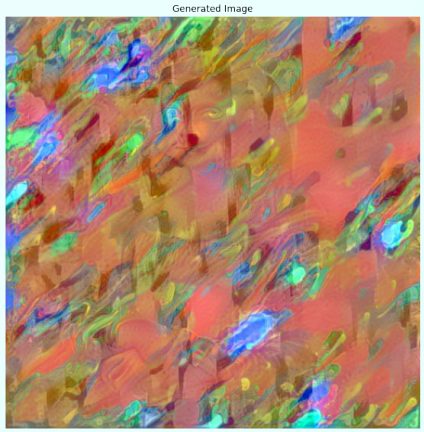
Manual

Generated Image

LIMITATIONS OF THE ALGORITHM

- For each set of content and style images, we have to do fine variations in weight values for the output to be better. It is not possible to have a fixed set of weights which work on all images. If the weights are not right then the output might be unvalid like below:





- The time taken for output image generation is almost 8 seconds per iteration. This can further be reduced using an end-to-end CNN model built specifically for NST as introduced in Johnson et al.

THANK YOU