PES University
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UE19CS343 - Topics in Deep Learning
Project Report

Generating Artistic Paintings from Photographs using CycleGAN

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1. Introduction

It has been found that redrawing an image in a particular form of art requires a well-trained artist and much time, and reasonably so.

However, AI now being capable of creativity beyond human imagination, our project aims to transfer the painting style and features of an artist to an image. This could help art enthusiasts visualise how some of their photographs would look if painted by their favourite artists by emulating renowned painters to recreate their images.

Thus, our goal is to turn photo-realistic images into synthetic artworks without human intervention.

2. Literature Survey

2.1. Paper 1

DualGAN: Unsupervised Dual Learning for Image-to-Image Translation (2017)

Model used - DualGAN

Synopsis - Inspired by dual learning from natural language translation, they aimed to provide a general-purpose solution for image-to-image conversion through a novel unsupervised dual learning framework. Compared to GAN, in almost all cases, DualGAN produced results that were less blurry, and better captured features (e.g., texture, colour, and/or style) of the target domain

2.2. Paper 2

Unpaired Image-to-Image Translation using Cycle-Consistent Adversarial Networks (2020)

Model used - CycleGAN

Synopsis - An approach for learning to translate an image from a source domain X to a target domain Y in the absence of paired examples while preserving the colour composition between the two, using cycleGANS. They used it for object transfiguration, season transfer, photo generation from paintings & more.

2.3. Paper 3

APDrawingGAN: Generating Artistic Portrait Drawings from Face Photos with Hierarchical GANs (2019)

Model used - Hierarchical GAN

Synopsis - This work makes use of a hierarchical GAN by combining both a global network (for images as a whole) and local networks (for individual facial regions) which allows dedicated drawing strategies to be learned for different facial features. A novel loss function is developed to measure similarity between generated and artists' drawings based on distance transforms, leading to improved strokes in portrait drawing.

2.4. *Paper 4*

Artgan: Artwork Synthesis with Conditional Category GANS (2017)

Model used - Conditional GAN

Synopsis - This paper solves the problem of synthetically generating complex images such as artwork that have abstract characteristics

The key innovation of this work is to allow backpropagation of the loss function w.r.t. the labels to the generator from the discriminator. With the feedback from the label information, the generator is able to learn faster and achieve better generated image quality.

2.5. *Paper 5*

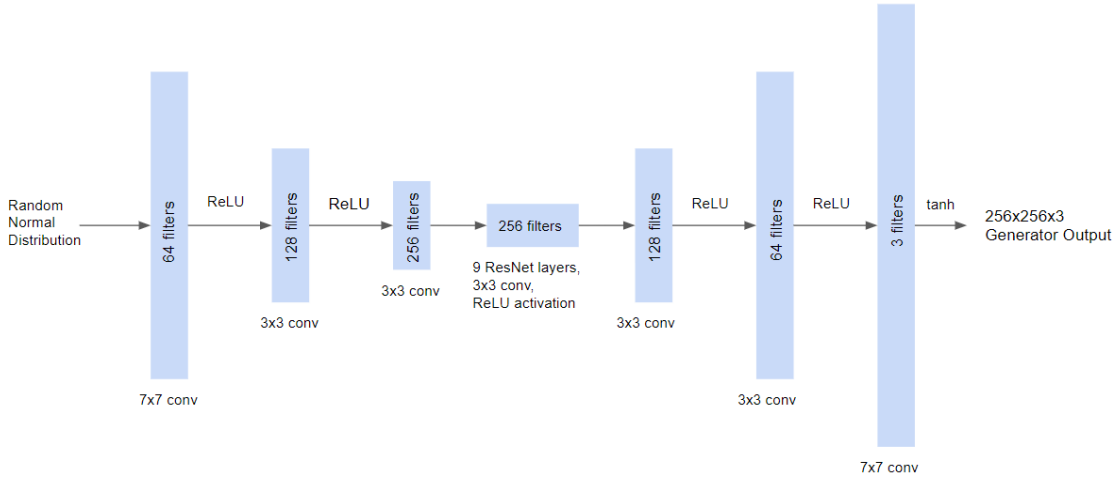
StarGAN: Unified Generative Adversarial Networks for Multi-domain Image-to-Image Translation (2018)

Model used - StarGAN

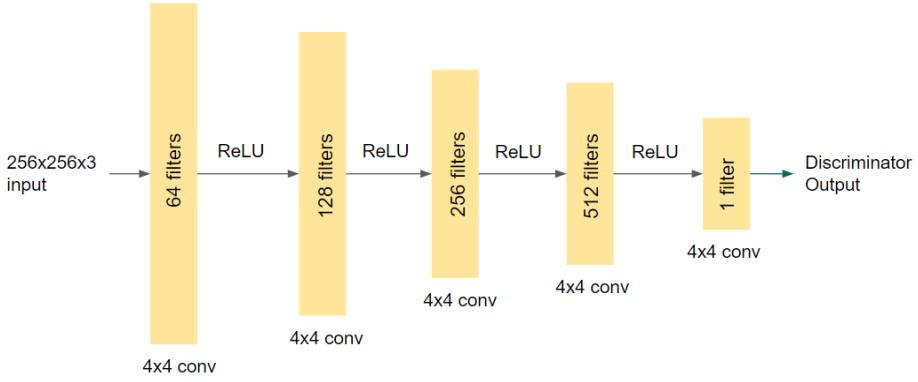
Synopsis - This paper makes use of StarGAN, which can perform image-to-image transformations for multiple domains using only a single model. This allows for training of multiple datasets with different domains within one network, as well as added flexibility in translating an input image to the desired target domain.

3. Design and Implementation

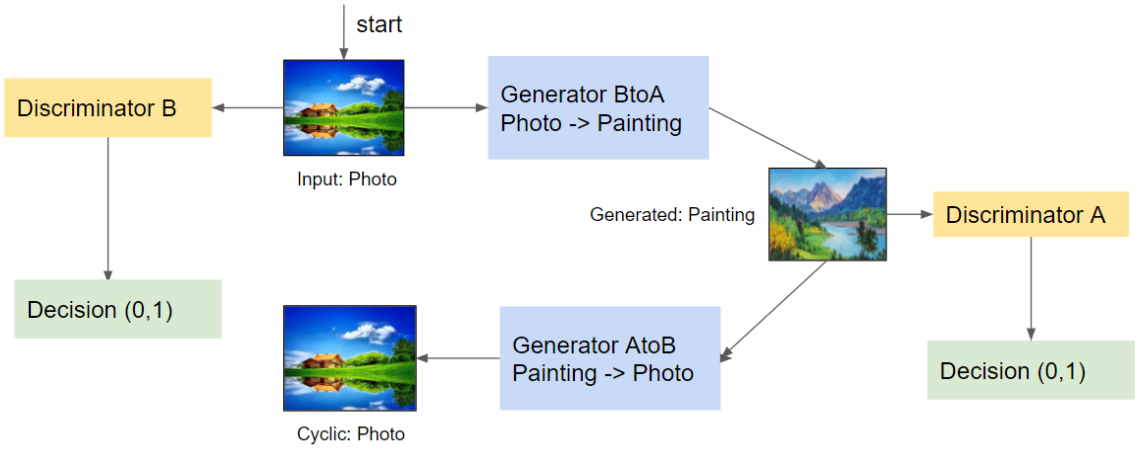
3.1. Generator Architecture



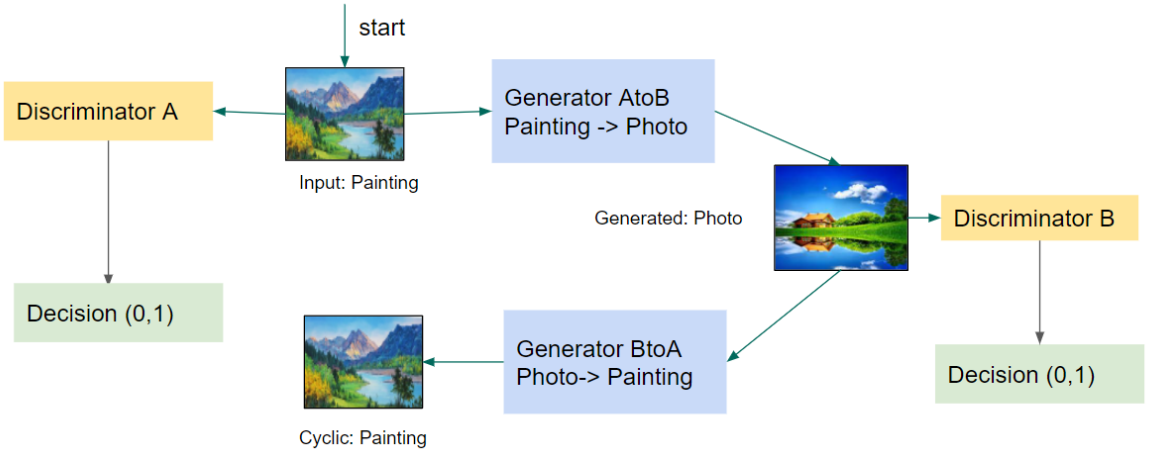
3.2. Discriminator Architecture



3.3. CycleGAN (Forward) Implementation

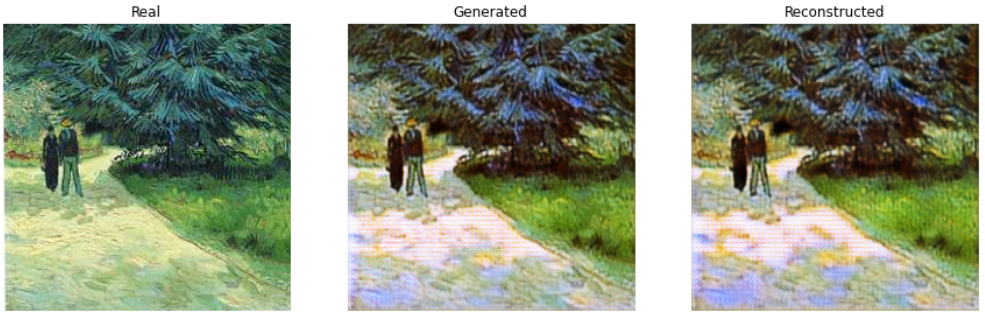


3.4. CycleGAN (Backward) Implementation

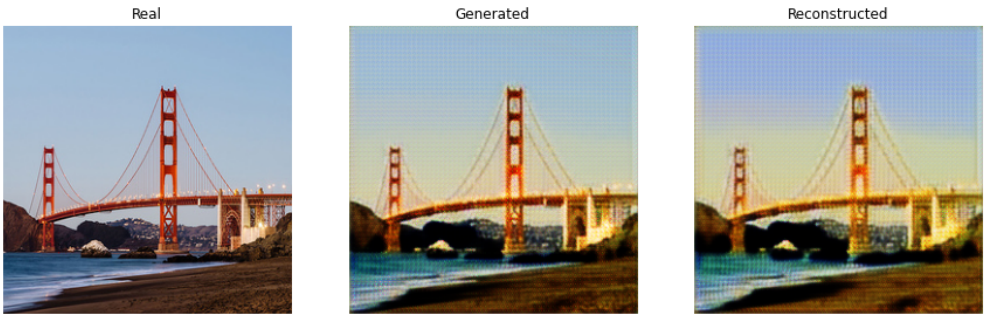


4. Results

4.1. Training Results



4.2 Testing Results



5. Conclusion and Future Scope

We implemented an artistic style generating architecture called the CycleGAN. This algorithm learned to mimic the style of Van Gogh's entire artwork collections. The model could generate fantastic Vincent style images but with different focus. Pictures generated by CycleGAN look more realistic and are regarded as real photos by most people. In a word, CycleGAN can serve as the better choice of artistic style generator based on various style/content requirements.

In our future work, we'd like to explore more different computer vision architectures, probably some other Generative Adversarial Network. Also, the input artworks could be extended to other famous artists like Monet, Picasso or even some oriental painters. We may also consider transfer learning techniques if the data set is relatively small. Finally, our evaluation metrics might be further improved by introducing more mathematical and statistical components.