ARTficial

by Art Ficial

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Project Abstract

The art and design industry is one of the most time inefficient industries because it takes numerous hours to create even simple artworks. This leads to artists compromising over their creativity in order to meet deadlines for their projects. In addition to that, they are undercompensated for hours they put in. Furthermore, individuals with non-artistic background have hard time getting into the art and design industry because of their less prior experience and talent. Our project will solve these problems by aiding in generating artworks in a more timely manner using neural-networks techniques. This way, even non-artistic people can create amazing artworks with ease and confidence. Moreover, the blockchain industry is heavily influenced by NFTs (Non-Fungible Tokens), which are basically ERC-721 tokens created on top of ethereum blockchain. Once, an NFT is created it cannot be altered since they are non-fungible, so artists prefer to create and sell their artwork in the form of NFTs. Our project will aid NFT artists by assisting them in cases such as when they want their artwork to be influenced by certain famous artist, they can use our Neural Style Transfer-based technology to create their artwork accordingly. This project will also allow users to playaround with their custom images in different themes for promotional or personal usage. ARTficial will also be used as an assistive technology for artists in the development cycle of their artwork that will help them in their creative process.

1 Introduction

The advances of Artificial Intelligence are prevalent in almost all of the fields including Finance, Healthcare, Transportation, Robotics and several other areas. But one of the most exciting areas in which the usage of Artificial Intelligence is surging is arts and entertainment industry. This is possible due to neural networks which are the Basis of deep learning, neurons are divided into different layers. The first layer generally receives the data as input, the layers between first and last layer also known as hidden layers perform the processing on the result coming from first layer, and finally the last layer predicts the output. The most common type of neural network is the Artificial Neural Network in which each neuron in one layer is connected to every neuron in the neighboring layer. Each neuron is function that takes input from the previous neuron and outputs the calculated value called activation number and all of these neurons are connected through edges having certain weighs.

The most useful and common type of neural network used in image processing is the Convolutional neural network (CNN). Treating data as spatial and instead of each neuron being connected to another neuron, CNN has a different architecture in which neurons are connected only to their neighboring neurons having same weights. Compared to Artificial Neural Network, CNN takes less computation power and they are independent to the position of object in an image. CNN takes a grid (usually 3x3) and slides it throughout the complete image and puts the calculated value at each position in the feature map. This feature map holds values in a specific range (ideally 0-1) which are responsible for detecting the patterns in the image. If an image is complex, it will have more than one feature maps. In that case, these feature maps are stacked together in a way that N-Dimensional array is converted into 1 Dimensional array. This 1D array is further connected into a layer of neurons forming a neural network which is responsible for classification of data. Furthermore, CNN has a pooling layer that downgrades the feature map for faster processing and it involves a RELU operation which is basically a phenomenon to convert all nonlinear results to linear for a faster computation. We will be using Generative Adversarial Networks (GAN) for image generation which are essentially a type of deep-learning based unsupervised models in which two models competes to generate a generative model. GANs were designed by Ian Goodfellow in 2014 but today GANs are getting much appreciation for their extensive usage in various fields like Arts, Fashion, Video Games and facial reconstruction. There is varying architecture of GANs like Cycle GAN, pixel RNN, Disco GAN and Style GANS [1]. These architectures are further divided into different series such as Style

GANs are divided into Style GAN-1, Style GAN-2, Style GAN-3. For Image Processing and Computer Vision, Cycle GANs and Style GANs are used.

The most exiciting application in this area is the Neural Style Transfer which are the algorithms used for digital image manipulation. NST are the main component along with progressive GAN in the designing of Style GAN-1. These algorithms have huge applications in the fields of arts and image styling specially for artists to enhance their creativity level. But most of the work of AI in arts is still at initial or research level since it is relatively a new and emerging field and right now there aren't much applications built on top of these technologies. So, we aim to develop an application using AI and deep-learning based frameworks like Neural Style Transfers for image manipulation.

2 Related work

This section will include the relevant work that has been carried out previously in the form of different applications and research academia relevant.

Some of the related applications(web-based and mobile) that have been developed and display the usage of neural style transfers in different domains are as followed:

i. DeepArt.io

This web-based application is designed for users of all ages to create new original artwork. It is designed to aid users by allowing them to play around by inputting their custom images and turn them into different provided styles. It uses neural style transfers like we will, to separate the style elements from one reference image and use it to imitate and mimic work of renowned artists. This website along with rest of its alternatives are mostly trained on western data, which is limited to providing altering image in retrospective of western artists styles. [2]

ii. Prisma

Prisma is mobile application that primarily focuses on photo-enhancement and editing using neural networks as well as other artificial-intelligence techniques to transform the pictures. It also utilizes the underlying algorithm and techniques used in the previously discussed web-application DeepArt. Because of which, it also utilizes Neural Style Transfer algorithm. It allows individuals to select one of variety of filters to alter and transform their images completely with discerning designs with ease, and further share them with friends. Recently, the project boomed the tech market by raising funding of over 6 million $ in its series funding. [3]. At core, Prisma uses a NST-based algorithm to alter the images. But again, the problem is that it is trained mainly using western data. This is one of the aspects we are planning to work on for it.

Following are some of the research papers that emphasize on implementation of Neural Style Transfers as well the related GANs working relevant to the domain:

i. A Style-Based Generator Architecture for Generative Adversarial Networks

In this paper, the research team from NVIDIA have proposed a new architecture for generative adversarial networks, inspired from style transfer literature. This new architecture style seems to adapt the unsupervised learning approach by segmenting the very blatant features. For example, in case of testing and training on human face, it affects the

freckles, if any, on the face or even hair on the head. All in all, it allows instinctive control over the process. This opens an enormous space for customizability in several levels when editing. This new architecture refines and enhances the generation of sounds, videos and especially images to a great extent. This paper also quantifies this quality in interpolation by further suggesting two new general techniques that can be utilized in any of the generator architecture. Furthermore, it also provides a new extensively varied and standardized dataset of human faces. [4]

ii. Image Style Transfer Using Convolutional Neural Networks

This research paper primarily deals with the problem of processing images in different designs. Outputting and detecting only the interesting parts of a reference image has always been a hectic task. One of the recurring problems that has been common in all of the previous approaches is the depiction and portyal of images that precisely represent the semantic information in order to segregate the image content from the rest of the image. In this paper, the researchers utilize the image depictions from CNN(Convolutional Neural Networks) that have been optimized for object detection, that can aid in segregating high-level information. The researchers introduce this neural technique that can easily separate and then merge and fuse the styles from a reference image. One of the usecases may be to utilize the numerous well-known artworks and convert their styles on a custom image. This deep image depictions learned by the CNNs can help aggregate images for high-level manipulation [5]

iii. Neural style transfer: a paradigm shift for image-based artistic rendering

In this paper, the researchers have discussed the problem of the need of evolving of Neural-Style-Transfers. The artwork industry is a arguably competitive one which is why there is a dire requirement on the consideration of design aspects as well as other complimenting production mechanisms while rendering of the final product. In the past decade, there has been a lot of work done in the domain of Image-Based Artistic Rendering (IB-AR) as researcher have found numerous techniques to imitate the aestheticism of well-known artworks. Example-Based Rendering is one of the paradigms in IB-AR that aids in the simulation of old-school artworks with high-accuracy but is very restricted and bound as it requires a pair of priorly formed photos for training or only segregates worthless features. The research paper further deals and discusses the potentials of Neural Style Transfers in order to recognize different major applications including proffering of complex artworks. [6]

iv. Pictory: combining neural style transfer and image filtering

Like Prisma, Pictory is another mobile application that allows its users to render artistic custom images but in addition to using Neural Style Transfers, it also utilizes nonlinear image filtering, which is user-controlled. This is a unique combined approach that was absent in DeepArt.io as well Prisma. The way its underlying mechanism works is that using Deep CNNs, it will transfer the design and style features as a whole while utilizing image filtering to validate artistic look-and-feel at the present level. This approach implements this two-phase procedure; firstly pre-defining the neural networks based image editing using the pre-trained model and then applying static filters to stylize the output. This two-step mechanism will help in changing the output to a large extent. [7]

So, just like Prisma and DeepArt uses Neural Style Transfer for image generation and manipulation, our project will also use NST and styleGANs algorithms for photo editing and manipulation that will allow users to generate creative artwork for their personel or professional purposes. Such unique features may include eastern inspired themes or specific era related filters.

3 Project Rationale

The goal and motivation behind taking this as our final year project is the lack of work done in the given subject. Neural Style Transfer, despite being a hot domain in Computer Vision, there is not a lot of work done relevant to this type deep-learning optimization technique. The market of IB-AR (Image-Based Artistic Rendering) is yet to expand. Artists have a hard time working on major artistic pieces as they require several hours of perfecting themes and colors. Neural Style Transfers make this process exponentially quicker. Neural Style Transfers are a strong solution to this problem of generating artistic images with little to no effort. This will make the process of creating artworks exponentially efficient and more error-free.

Also, another advantage of this approach would be that the working behind Neural Style Transfers is also very simple as by inputting a custom image, and a reference image, the model can capture the styling and important components of the reference image and apply it on the custom image, thus resulting in an effortless masterpiece. Such an example can include using an old painting of Picasso as a reference and then inputting a portrait of someone, we can generate the portait of that individual in style of Picasso as if Picasso himself did the painting.

3.1 Aims and Objectives

- This project aims to improve the artistic domain by using neural network techniques, particularly NSTs.
- To reduce the workload of professional artists and designers.
- To help users view their custom images in different styles and themes effortlessly.
- To develop a product that can be used as an assistive technology by artists for improving in designing their artworks more efficiently.

3.2 Scope of the Project

The scope of this project will be regarding but not limited to recent advancements in Image- Based Artistic Rendering (IB-AR) and computer vision.The project will facilitate the conversion of one input image into theme and style of another reference image using neural style tranfer. With the help of our project, aesthetically looking images could be generated that may also be utilized for promoting the tourism industry of a particular place. The scope of ARTficial can also be extended to specific Era/Time period styled image generation. In addition to that, project will impact the blockchain industry by aiding NFT creators to create original artworks for exponential values. It will Help in regularizing and democratizing photo editing to a great extent by allowing people with lesser to none prior experience in image-editing to create aesthetic valuable artworks. It will facilitate the users to choose from numerous predefined custom IB-AR (Image-Based Artistic rendered) filters/styles as well for generating creative images.

4 Working of End-Product of our Project:

The End product of our project will be an open source application where artists can generate their artwork using our application in these simple steps:

i) Gathering Images:

The users will provide two images, one of the images is the style reference and second image is the user provided image upon which the style is transferred.

1 The Starry Night

2 Mona Lisa

ii) Processing Images to generate a Styled Image:

For example, if our style reference is "*the Starry night*" and the user provided image is "*Mona Lisa*", then the algorithm will generate a third image which is actually the Mona Lisa (user provided image) but in the style of The Starry Night (style reference)

3 NST Generated Image

iii) Generating the resultant Image through the Interface:

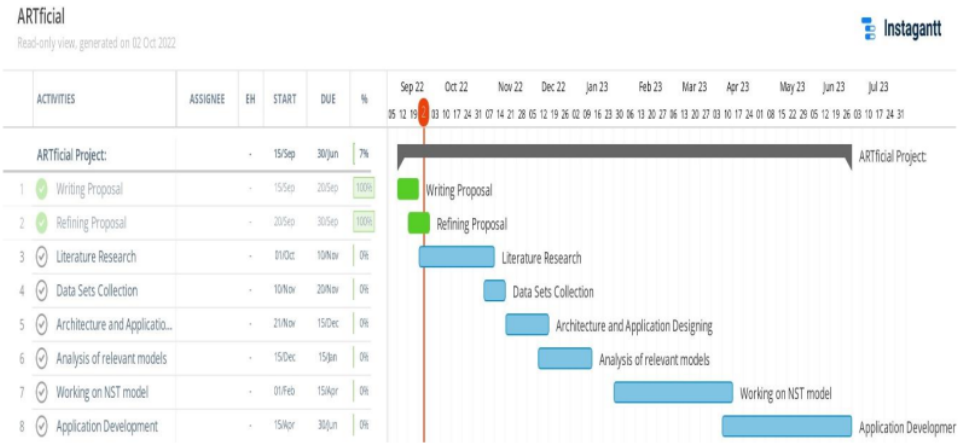
Users can generate their images using the model through an interface where first they will provide two input images, one of them being the image they want to apply style and second image which will be the styling reference. Our model will process the images and the interface will provide the resultant styled image as output to users.

5 Individual Tasks

Team Member	Activity	Tentative Date
Abdul Rehman Aziz	**Writing Proposal**	15th September 2022 – 20th September 2022
M. Daniyal Javed,	**Refining Proposal**	20th September 2022 – 30th September 2022
Abdul Rehman Aziz, M. Daniyal Javed	**Literature Research**	1st October 2022 – 10th November 2022
Abdul Rehman Aziz, M. Daniyal Javed	**Data Sets Collection**	10th November 2022 – 20th November 2022
M. Daniyal Javed, Abdul Rehman Aziz	**Architecture & Application Designing**	21st November 2022 – 15th December 2022
M. Daniyal Javed, Abdul Rehman Aziz	**Analysis of relevant models**	15st December 2022 – 15th January 2023
Terminal Exams		

M. Daniyal Javed, Abdul Rehman Aziz	**Working on NST models**	1st February 2023 – 15th April 2023
Abdul Rehman Aziz, M. Daniyal Javed	**Application Development**	15th April 2023 – 30th June 2023

6 Gantt Chart



7 Tools and Technologies:

TensorFlow	Library for machine learning and artificial intelligence also used across a range of tasks but has a particular focus on training and inference of deep neural networks.
MongoDB	This will be our database for the project.
Scikit-Learn	Machine learning library for the Python programming language. Features various classification, regression and clustering algorithms including support-vector machines.
Collaboratory	This environment by google will be used to train our models. With this, we're free from the need to buy expensive hardware.
OpenCV	This is a python library named "cv2" that enables real-time computer vision.
Figma	This will be used for the UI design.
NumPy & Pandas	These are the most popular python packages that will be used for every kind of data wrangling and management.
ReactJS	This will be used to build our front-end deployable to the web.
Matplotlib	Former is the data visualization library in Python. We can build all kinds of graphs and plots to interpret data.
FastAPI	A recent tool in python that allows us to develop REST-API. This will handle all our HTTP requests.
Flask	Used for developing web applications using python.
Cloudinary	A third-party image storage web-service solution.

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