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SB. SATHYAPRIYA

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DEPARTMENT OF INFORMATION TECHNOLOGY

CERTIFICATE

This is to certify that the seminar titled "AI Art" submitted by Sathyapriya SB Register number RA2011008020021 of Semester V is a bonafide account of the work done by him/her under our supervision, during the academic year 2022-2023

SEMINAR GUIDE   **HEAD OF THE DEPARTMENT**

B. SATHYA BAMA   **Dr. RAJESWARI MUKESH**
Assistant Professor, IT   Department of Information Technology
SRMIST, Ramapuram   SRMIST, Ramapuram

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ABSTRACT

Recent advances in machine learning have led to an acceleration of interest in research on artificial intelligence (AI). This fostered the exploration of possible applications of AI in various domains and also prompted critical discussions addressing the lack of interpretability, the limits of machine intelligence, potential risks and social challenges.

In the exploration of the settings of the "human versus AI" relationship, perhaps the most elusive domain of interest is the creation and understanding of art. Many interesting initiatives are emerging at the intersection of AI and art, however comprehension and appreciation of art is still considered to be an exclusively human capability. Rooted in the idea that the existence and meaning of art is indeed inseparable from human-to-human interaction.

The motivation behind this is to explore how bringing AI in the loop can foster not only advances in the fields of digital art and art history, but also inspire our perspectives on the future of art. The variety of activities and research initiatives related to "AI and Art" can generally be divided into two categories:

1) AI is used in the process of analyzing existing art; or
2) AI is used in the process of creating new art.

In this, relevant aspects and contributions of these two categories are discussed, with a particular focus on the relation of AI to visual arts. In recent years, there has been a surge of interest among artists, technologists and researchers in exploring the creative potential of AI technologies. The use of AI in the process of creating visual art was significantly accelerated with the emergence of Generative Adversarial Networks (GAN).

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INTRODUCTION

AI Art is a current trend in the world of art that is gaining popularity day-by-day. The concept is based around the idea that machine learning algorithms are capable of producing original images as output, when appropriately trained using large computational resources on a vast amount of image data. These machine learning algorithms are based on the technology called **General Adversarial Networks** or GANs for short.

This seemingly simple process is actually more complicated than one might think since it is highly dependent on the size and what's most important – quality of the dataset as well as time spent on training the algorithm. All of these variables, in turn, depend on the power of the graphics cards used (we use a grid of industrial grade GPUs), e.g. – the more computational power, the larger the dataset and the lesser the time it takes for every model to train. In our context, "training the model", in simple terms, means that the algorithm continuously generates images through the generator component and the other component of the model called the discriminator "decides" whether the output of the generator is close to the original dataset or not. Hopefully, you are not too much bored by the slightly technical terminology.

After countless hours of training, the model, based on what it learnt during the training process, is then able to generate something completely new, something that has never been drawn before – original AI art.

It is beautiful how technology has advanced to the point where it is able to engage in art creation. Only 15 years ago, this was barely considered a possibility and today AI Art Shop displays a collection of over 50 AI Portraits with human faces so realistic that it is almost impossible to tell the difference between a human-made portrait and an AI portrait. So, are we entering the new era where robots are going to completely replace human artists? The answer is probably no, at least in the near future. AI algorithms, with appropriate training, are indeed able to generate original images, however a lot of the output, even with a lot of training, is either noise or art that believe me you would not like to see. So, this is where human involvement comes in. There needs to be a team of people who understand art and are able to select and classify only the

best images. The next step once the paintings have been classified and named, is to use a different group of AI algorithms to increase the resolution of every selected image to allow for the best quality of paintings.

We can see that there is definitely a degree of human involvement, but the creative process is done completely by Artificial Intelligence. As of the time of writing of this article, we offer custom made one-off exclusive AI canvas prints. Our AI paintings are brought to life using a state-of-the-art Giclee Print technology with an Ink Jet machine, guaranteeing 99% colour accuracy as well as outstanding colour depth and longevity. One interesting trait of AI paintings is that on some of them we are able to observe brush strokes and certain 3D elements that the AI overlaid on certain parts of the painting. Coupled with our vector correction and resolution adjustment AI technologies, this allows to create AI paintings with an oil-painting effect. For some of our paintings it is hard to even tell whether the painting is a canvas print or an oil painting when looking from a distance - all because of the ultrahigh resolution (1000 dpi) and 3D brush stroke effects that are the product of AI imagination.
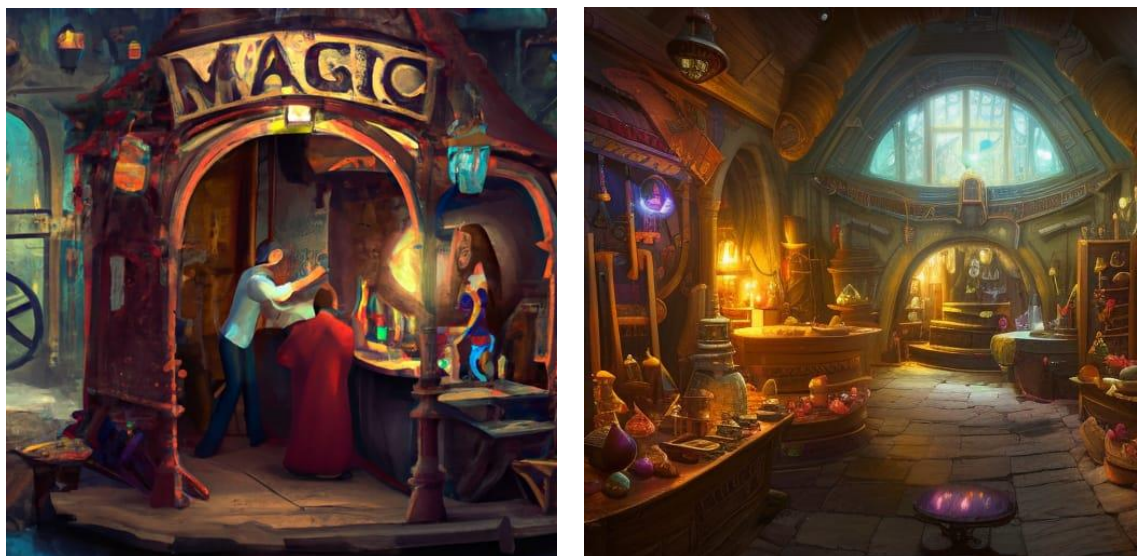

Fig 1.1 Introduction

CHAPTER II
MOTIVATION

This new AI art resides somewhere between painting and photography. It lives in a possibility space as large as painting and drawing—as huge as human imagination. But you move through the space like a photographer, hunting for discoveries. Tweaking your prompts, you may arrive at a spot no one has visited before, so you explore this area slowly, taking snapshots as you step through. The territory might be a subject, or a mood, or a style, and it might be worth returning to. The art is in the craft of finding a new area and setting yourself up there, exercising good taste and the keen eye of curation in what you capture. When photography first appeared, it seemed as if all the photographer had to do was push the button. Likewise, it seems that all a person has to do for a glorious AI image is push the button. In both cases, you get an image. But to get a great one—a truly artistic one—well, that's another matter.

Our machines have crossed a threshold. All our lives, we have been reassured that computers were incapable of being truly creative. Yet, suddenly, millions of people are now using a new breed of AIs to generate stunning, never-before-seen pictures. Most of these users are not, like professional artists, and that's the point, They do not have to be. Not everyone can write, direct, and edit an Oscar winner like Toy Story 3 or Coco, but everyone can launch an AI image generator and type in an idea. What appears on the screen is astounding in its realism and depth of detail. Thus the universal response: Wow. On four services alone— **Midjourney, Stable Diffusion, Artbreeder, and DALL-E** —humans working with AIs now cocreate more than 20 million images every day. With a paintbrush in hand, artificial intelligence has become an engine of wow.
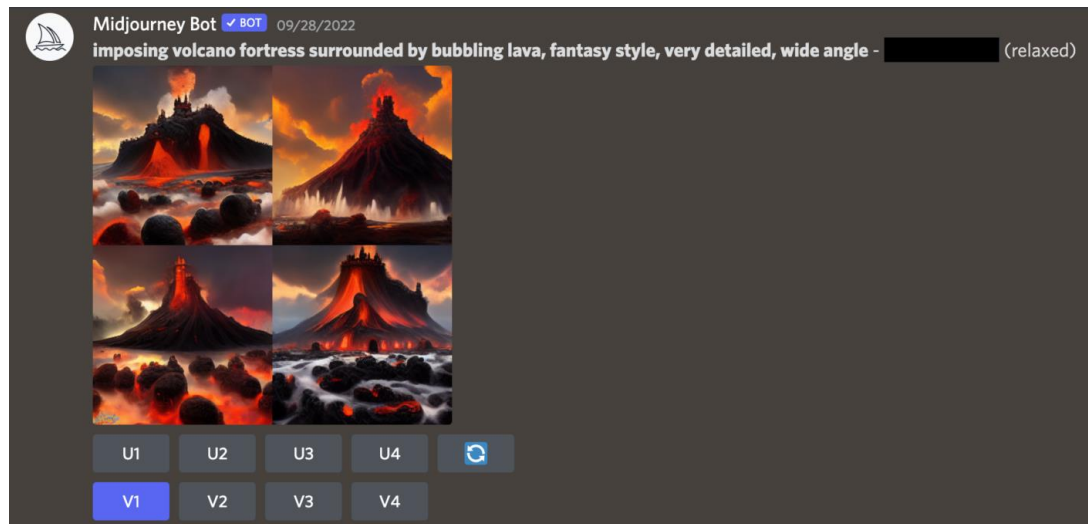
Fig 2.1 Midjourney users create images using Discord bot commands

Because these surprise-generating AIs have learned their art from billions of pictures made by humans, their output hovers around what we expect pictures to look like. But because they are an alien AI, fundamentally mysterious even to their creators, they restructure the new pictures in a way no human is likely to think of, filling in details most of us wouldn't have the artistry to imagine, let alone the skills to execute. They can also be instructed to generate more variations of something we like, in whatever style we want—in seconds. This, ultimately, is their most powerful advantage: They can make new things that are relatable and comprehensible but, at the same time, completely unexpected.

So unexpected are these new AI-generated images, in fact, that—in the silent awe immediately following the wow—another thought occurs to just about everyone who has encountered them: Human-made art must now be over. Who can compete with the speed, cheapness, scale, and, yes, wild creativity of these machines? Is art yet another human pursuit we must yield to robots? And the next obvious question: If computers can be creative, what else can they do that we were told they could not?

It is no exaggeration to call images generated with the help of AI cocreations. The sobering secret of this new power is that the best applications of it are the result not of typing in a single prompt but of very long conversations between humans and machines. Progress for each image comes from many, many iterations, back-and-forths, detours, and hours, sometimes days, of teamwork—all on the back of years of advancements in machine learning.

CHAPTER III

ALGORITHMS TO CREATE AI ART

There are various ways in which AI is used to create art. AI algorithms can generate images or videos based on a set of parameters or create new images by combining and altering existing images. Neural networks can be used to create images or videos that mimic the style of a particular artist or to create images or videos that are similar to a particular type of art.

The go-to technique for generating new artwork using the style of other existing art is through Generative Adversarial Networks. The method of transferring the style of an art piece to another art, when accomplished using Deep Neural Networks, is called neural style transfer (NST). The primary idea behind NST, which was first proposed in this paper in 2015, is that to obtain the representation of the style of an input image, a feature space originally designed to capture texture information is used. By including the feature correlations of multiple layers, the authors obtained a stationary, multi-scale representation of the input image, which captures its texture information but not the global arrangement.
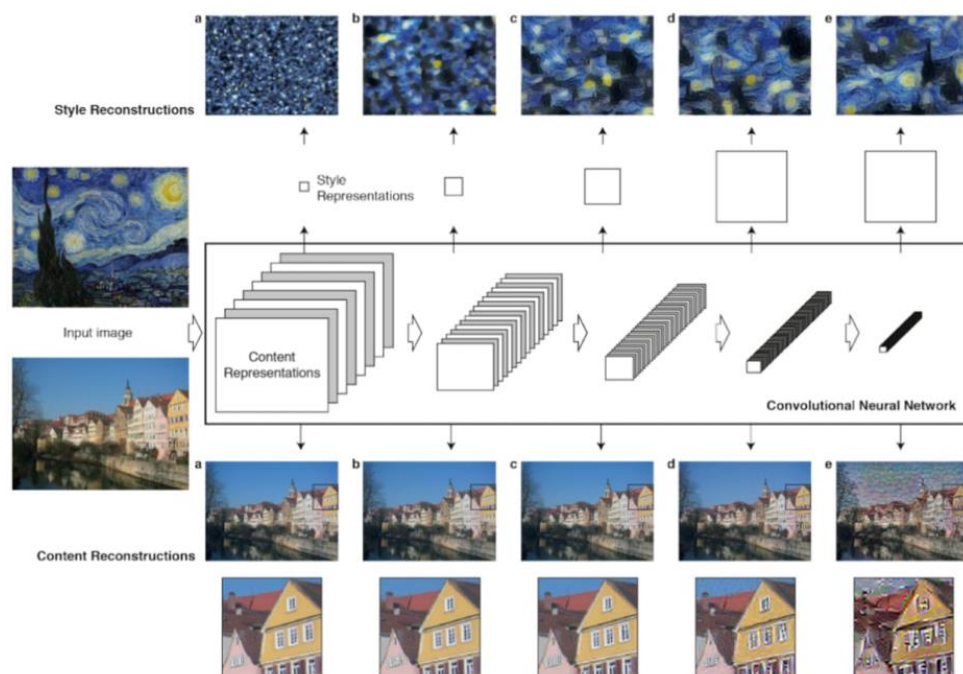

Fig 3.1 Convultional Neural Network(CNN)

The authors found out through experiments that the representations of content and style in the CNNs are separable. That is, both representations can be manipulated independently to produce new, perceptually meaningful images. This finding has been the underlying basis for all successive methods proposed in the literature for Neural Style Transfer used in AI-generated art.

Apart from the neural style transfer, there are other algorithms that can create AI art—

DALL·E 2

One of the most revolutionary algorithms that use AI for creating new art is DALL·E 2 by OpenAI. DALL·E 2 generates images using only a textual prompt given by the user. In a later section, we will discuss the architecture and capabilities of DALL·E 2 in further detail.

GANs

Generative Adversarial Networks (GANs), proposed in 2014 in this paper, are typically composed of two neural networks pitted against one another to make both of them better learners.

Suppose we have to generate new images to augment a dataset for image classification. One of the two networks is called a generator, the deep network that outputs new images. The other network is called a discriminator and its job is to classify whether the image given to it as input is an original or a fake image created by the generator.

In successive iterations, the generator tries to mimic the original images more closely to fool the discriminator, while the discriminator tries better to distinguish the real images from the fake. This adversarial game (minimax problem) trains both networks. Once the training loop is complete, the generator can output realistic images (almost indistinguishable from the original), and the discriminator has become a good classifier model.

Fonts

New engaging (and consistent) fonts can also be generated using GANs for write-ups, like that proposed in this paper.

Fig 3.2 Examples of generated Fonts

Human faces

For illustrations, movie characters, etc., which alleviates privacy concerns. This website shows images of human faces that don't actually exist because the images are created using the StyleGAN2 model. An example is shown below.

Cartoon/Anime characters

GANs have also been used to generate cartoon and anime characters. This enables writers to get new ideas on character drawings and even create scenes without drawing each frame (of the video sequence) for their episodes.

Sketches

Generating sketches using GANs has several advantages like augmenting models with multimodal data for style transfer, super-resolution, etc. They can also be used as the base structure for creating more complicated art.

Fig 3.3 Generated sketches using the SkeGAN model

CHAPTER IV
LITERATURE REVIEW

Cetinic, Eva & She, James. (2021). Understanding and Creating Art with AI: Review and Outlook. Technologies related to artificial intelligence (AI) have a strong impact on the changes of research and creative practices in visual arts. The growing number of research initiatives and creative applications that emerge in the intersection of AI and art, motivates us to examine and discuss the creative and explorative potentials of AI technologies in the context of art. This paper provides an integrated review of two facets of AI and art: 1) AI is used for art analysis and employed on digitized artwork collections; 2) AI is used for creative purposes and generating novel artworks. In the context of AI-related research for art understanding, we present a comprehensive overview of artwork datasets and recent works that address a variety of tasks such as classification, object detection, similarity retrieval, multimodal representations, computational aesthetics, etc. In relation to the role of AI in creating art, we address various practical and theoretical aspects of AI Art and consolidate related works that deal with those topics in detail. Finally, we provide a concise outlook on the future progression and potential impact of AI technologies on our understanding and creation of art.

Besides employing deep learning models for enhancing research practices in art history, it is noteworthy to recognize the potential that tasks and data sources from the art domain have on the development of new computer vision and deep learning techniques. Digitized art collections are data sources of images that usually include rich contextual information related to the historical and technical aspects of their formation, but also represent a source of perceptually intriguing visual information which merges interweaving concepts of content and style. Because they comprise different layers of information, art collections represent a useful data source for addressing various and complex tasks of computational image understanding. In the context of art creation and production, AI technologies are starting to have an ever more important role. Not only in terms of digitally and AI produced art, but also in all the aspects of curation, exhibition and sale of traditional art as well. Having in mind the rapid shift of attention towards online platforms and digital showrooms due to the current global pandemic, the ongoing circumstances contributed to the already rising interest in crypto art and

blockchain technologies which have the potential to significantly impact and transform the art market.

Regarding the creation of art using AI technologies, in the last few years GAN-based approaches were dominating the AI Art scene. Recently, significant breakthroughs have been achieved in the development of multimodal generative models, e.g., models that can generate images from text. Technological advancement in this direction will probably have significant influence on the production and creation of art. Models that can translate data from different modalities into a joint semantic spacer present an interesting tool for artistic exploration because the concept of multimodality is integral to many art forms and has always played an important role in the creative process. Furthermore, it is evident that the increasing use of AI technologies in the creation of art will have significant implications regarding the questions related to authorship, as well as on our human perception of art. With the development of AI models that can generate content which very convincingly imitates human textual, visual or musical creations, many of our traditional, as well as contemporary, theoretical and practical understandings of art might become challenged.

CHAPTER V
RECENT TRENDS

One of the first auctions of AI art was arranged in 2016 in the Gray Area in San Francisco, where AI artists like Memo Akten and Mike Tyka exhibited images generated by Google's initial Deep Dream algorithm. In just two years, the first AI artwork arrived on the world stage of art. DeepDream is an experiment that visualizes the patterns learned by a neural network. Similar to when a child watches clouds and tries to interpret random shapes, DeepDream over-interprets and enhances the patterns it sees in an image.
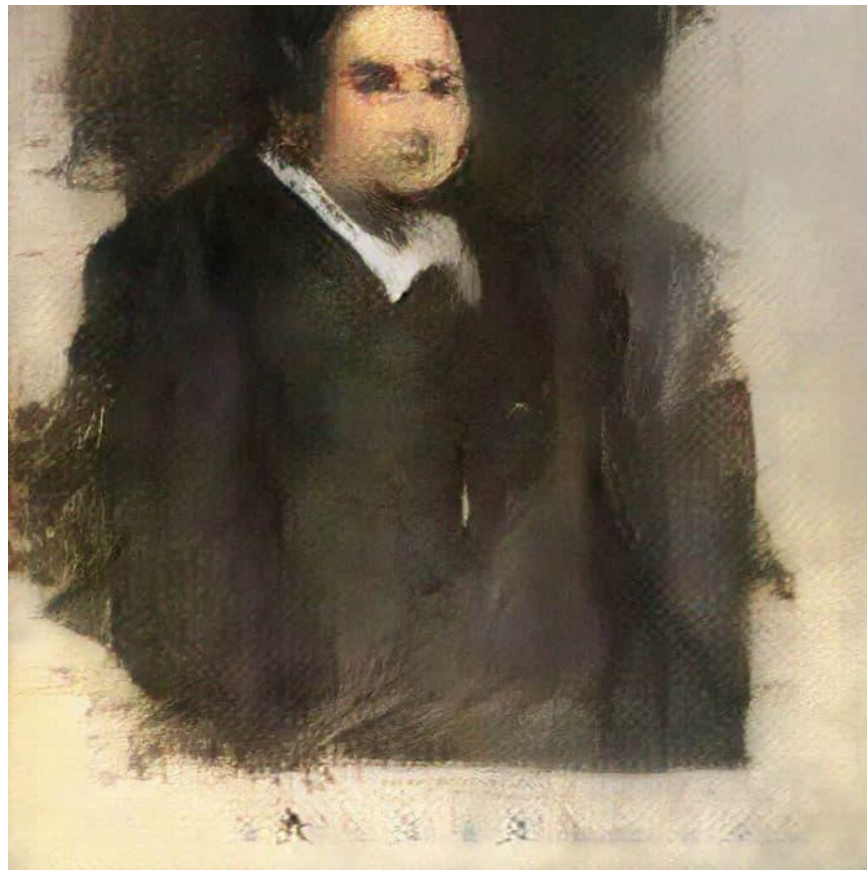

Fig 5.1 Portrait of Edmond de Belamy, 2018. Published by Obvious Art

In 2018, an AI-generated image was auctioned at Christie's, a rendered print by a Paris-based collective called Obvious. The auction of Portrait of Edmond Belamy was the first widely covered sale of an AI artwork; however, many data scientists and artists had already created and sold AI art before the auction.

Whenever new technology promises to revolutionize the art world, you can sense the anxiety that washes over the art community. With the arrival of text-to-image programs such as DALL-E-2 and Midjourney, we're all currently witnessing the rise of artificial intelligence in art. Many living, breathing artists feel as if their livelihoods are at stake, and understandably so. This is the end of art as we know it.

Photography arrived in the mid-1800s, critics dismissed it as a lazy substitute for art, or worse—the end of painting. It turns out photography was never a substitute, but a new medium in and of itself. Artificial intelligence has the same potential, as explored in a recent article by The Atlantic.Text-to-image AI tools are still in their infancy, but they're growing and evolving extraordinarily fast. Meanwhile, there are ongoing debates over the ethics and monetization of such tools and the legitimacy of AI-assisted art. It's too early to get definitive answers to many of these questions surrounding artificial intelligence, but if you're intrigued, we're here to shed light on how these tools work and what artists think of them.

GauGAN2 is NVIDIA Research's new AI model that goes even further. The model called GauGAN2, named after post-Impressionist painter Paul Gauguin creates photorealistic images from simple elements a user can draw with simple graphic tools like a paintbrush or paint bucket. Artists can also combine sketches with a short text to design their own landscapes. GauGAN2 is a widely used creative tool for visualizing concepts or creating simulated photos based on nearly any input of the creative mind.
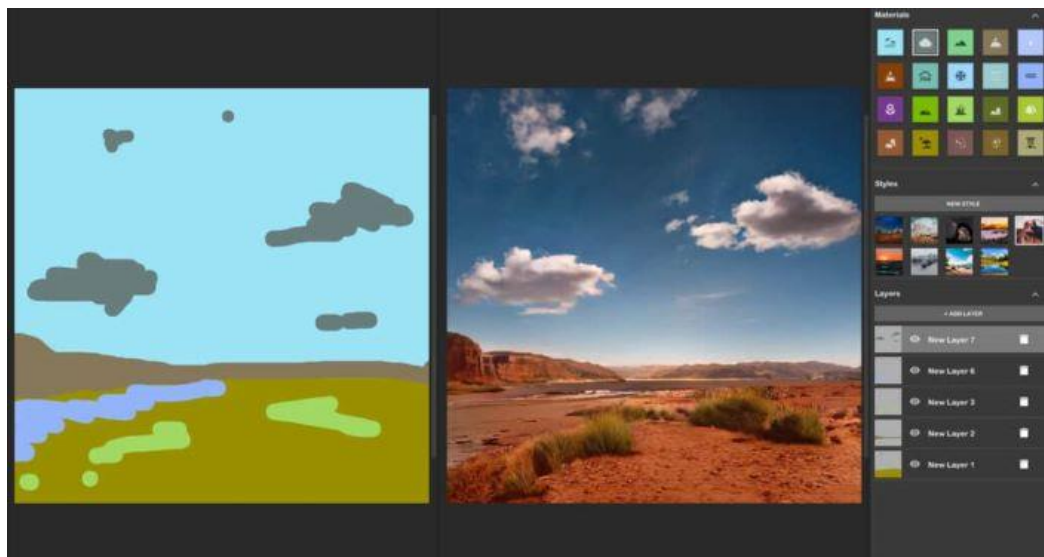

Fig 5.2 Photorealistic AI art tool powered by the GauGAN2 AI model, NVIDIA

CHAPTER VI
CONCLUSION

Current trends indicate that AI technologies will become more relevant in the analysis and production of art. In the last several years many universities have established Digital humanities (DH) master's and PhD programs to educate new generations of researchers familiar with quantitative and AI-based methods and their application to humanities data. We can expect that this will intensify the methodological shift from traditional towards digital research practices in the humanities, as well as result in a growing number of innovative research projects that apply large scale quantitative methods to study art-related historical questions.

From the perspective of computer vision, there are still many practical challenges that need to be solved in order to assist researchers working on cultural digital archives. In particular, those are problems related to annotation standards, advanced object detection and retrieval, cross-depiction, iconographic classification, multi-modal alignment and image understanding. The use of deep neural network models was previously conditioned on the availability of large-scale datasets. By utilizing the concept of transfer learning and label-scarce techniques such as few shot learning, deep neural network models can be applied on smaller-sized dataset and employed for different fine-grained tasks and various image collections. Those kinds of approaches will probably be exploited by many future domain-specific digital art history projects.

Besides employing deep learning models for enhancing research practices in art history, it is noteworthy to recognize the potential that tasks and data sources from the art domain have on the development of new computer vision and deep learning techniques. Digitized art collections are data sources of images that usually include rich contextual information related to the historical and technical aspects of their formation, but also represent a source of perceptually intriguing visual information which merges interweaving concepts of content and style. Because they comprise different layers of information, art collections represent a useful data source for addressing various and complex tasks of computational image understanding. In the context of art creation and production, AI technologies are starting to have an ever more important role. Not only in terms of digitally and AI produced art, but also in all the aspects of curation, exhibition and sale of traditional art as well.

Having in mind the rapid shift of attention towards online platforms and digital showrooms due to the current global pandemic, the ongoing circumstances contributed to the already rising interest in crypto art and blockchain technologies which have the potential to significantly impact and transform the art market. Regarding the creation of art using AI technologies, in the last few years GAN-based approaches were dominating the AI Art scene.

Recently, significant breakthroughs have been achieved in the development of multimodal generative models, e.g., models that can generate images from text. Technological advancement in this direction will probably have significant influence on the production and creation of art. Models that can translate data from different modalities into a joint semantic spacer present an interesting tool for artistic exploration because the concept of multimodality is integral to many art forms and has always played an important role in the creative process. Furthermore, it is evident that the increasing use of AI technologies in the creation of art will have significant implications regarding the questions related to authorship, as well as on our human perception of art. With the development of AI models that can generate content which very convincingly imitates human textual, visual or musical creations, many of our traditional, as well as contemporary, theoretical and practical understandings of art might become challenged

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