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AUTOMATED SELF SUPERVISED IMAGE COLORIZATION USING GAN

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ABSTRACT:

Image colorization is a fascinating and challenging topic in image-to-image translation. Image Colorization is the process of coloring a grayscale image by using a black and white image known as a grayscale image as input and obtaining the output in RGB format simply known as a color image. The fundamental aim is to convince the spectator that the outcome is genuine. Many cameras, such as surveillance cameras and satellite cameras, still capture grayscale images which are kind of hard to analyze. Over the last 20 years, a wide range of colorization methods have been created, ranging from algorithmically simple yet time- and energy-consuming procedures due to unavoidable human participation to more difficult but also more automated methods. Image colorization by hand is time-consuming and prone to human error. Automatic conversion has evolved into a difficult field that combines machine learning and deep learning with art. In this project, we built an image colorization framework based on a deep learning method known as Generative Adversarial Networks, or GANs for short. GANs are a type of generative modelling that employs deep learning techniques such as convolutional neural networks.

1.INTRODUCTION

What is Image Colorization?

The technique of adding colors to a grayscale image in order to make it more aesthetically appealing and perceptually significant is known as image colorization. These are considered complicated jobs that frequently necessitate prior knowledge of image information as well as manual changes to obtain artifact-free quality. Furthermore, because objects might have multiple hues, there are numerous methods to assign colors to pixels in an image, implying that there is no single solution to this problem.

Importance of Image Colorization:

Historic black-and-white photographs are recognized as irreplaceable works of art with outstanding artistic merit. However, because color is such a crucial component of visual representation, it is impossible to properly imagine the actual scene by looking at them. The colorization of black-and-white photos significantly modifies the viewer's perception.

Complexity involved in Image colorization:

Colorization is essentially the technique of assuming color information in places where it does not exist. Technically, providing three-dimensional RGB (Red, Green and Blue) color information to each pixel with respect to intensity of a grayscale image in a visually appealing, realistic manner is a difficult operation. To simplify the task's complexity, the colorization method employs a conversion to a suitable luminance-chrominance color space. Color spaces derived from RGB include YUV and CIELAB. CIELAB is a perceptually homogeneous color space created via nonlinear adjustments of RGB. The uniform changes in CIELAB components correspond to the uniform changes in human color experience. As a result, viewing two distinct colors in CIELAB can be approximated by the Euclidean distance between the corresponding is not perceptually homogeneous.

Modern Colorization Methodologies:

Technological advancements have focused attention on automated machine learning, particularly deep learning techniques. These strategies have been shown to be useful in a variety of computer vision and image processing applications. Deep learning models have achieved amazing success in a wide range of application fields in recent years (e.g., image classification, pedestrian detection and tracking, face detection, handwritten character classification, image super-resolution, photo adjustment, photo enhancement, sketch simplification, style transfer, in painting, image blending, denoising, etc.), implying that additional inventive advancements are on the way in the near future. Both machine learning and deep learning efficiently handle massive volumes of data while uncovering hidden patterns and creating acceptable approximations of latent knowledge. While machine learning creates a set of rules in data by extracting features based on some prior knowledge, deep learning extracts regularities more autonomously utilizing a hierarchical level of artificial neural networks. It is now possible to achieve remarkable colorization benefits in this manner. Furthermore, the quality assessment of colorization outcomes is still a hot topic in the scientific community.

2.LITERATURE SURVEY

Colorization is the process of giving a grayscale image actual hue. Convolutional neural networks were created specifically to handle picture data. Many authors have made promising contributions to this concept. Because cartoon images are so distinct from natural photos, ***Domonkos Varga*** [1] introduced the idea of the automatic coloring of cartoon images, which presents a challenge because colors vary from artist to artist. As a result, the data set was specially trained for cartoon images, with around 100000 images utilized in training and the rest for validation. However, color uncertainty is significantly larger in cartoons than in natural images, and judgment is subjective and slow.

Shweta Salve [2] presented a similar approach based on Google's Inception ResNet V2 image classifier. Encoder, Feature extractor, Fusion layer, and Decoder are the four pieces of the system model. Given sufficient resources, such as CPU, memory, and a large data set, the system can deliver satisfactory results. This is mostly a proof-of-concept project.

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Yu Chen: [3] offered a method for dealing with the difficulty of coloring old Chinese films. They fine-tuned the whole model by combining existing data with their data collection of Chinese photos. The network combines low and midrange features taken from VGG-16 with multi-scale convolution kernels.

V.K. Putri: [4] devised a technique for turning simple sketches into vibrant graphics. In the CIE Lab color space, it uses a sketch inversion model and color prediction. This method can handle hand drawn sketches with a variety of geometric changes. The restriction discovered was that the data set is extremely limited, although it performs well in uncontrolled situations. Using a large data collection and a single feed-forward pass in CNN.

Richard Zhang: [5] developed an optimal approach. Their major emphasis is on the training part, left is the source and right are the fully automatic predicted output image. They tested the results on human volunteers and were able to deceive 32% of them. Various numbers of neurons are possible.

Various architectures were employed in the various attempts. According to certain studies, the number of neurons is about equal to the dimension of the feature descriptor retrieved from each pixel coordinate in a gray-scale image.

3.SYSTEM DESIGN & UML DIAGRAMS

SYSTEM ARCHITECTURE:

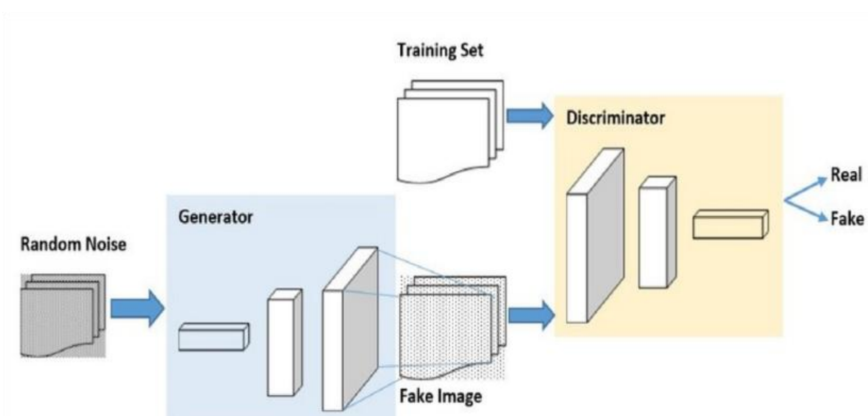

Figure: System Architecture Diagram

The architecture diagram depicts the relationship between the system's many components. This graphic is critical for understanding the overall notion of the system. An architecture diagram is a system diagram in which the main parts or functions are represented by blocks connected by lines that demonstrate the relationship of the blocks.

WORKFLOW DIAGRAM:

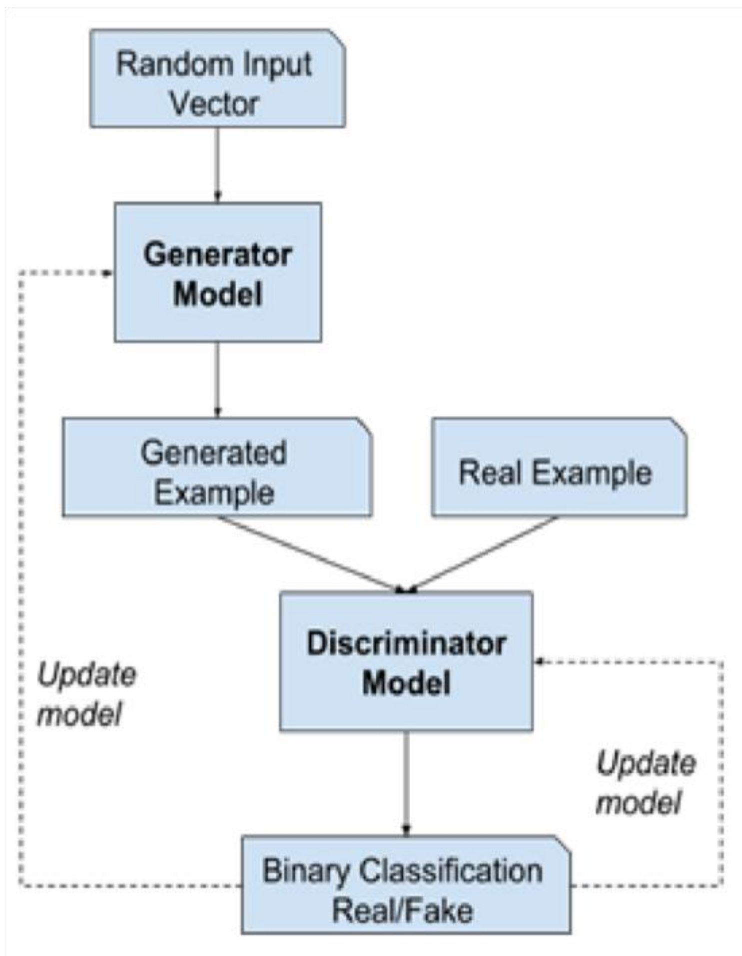

Figure: Working Of GAN

A workflow diagram is a simple visual representation of a business process. You can use it to symbolize the numerous duties involved, as well as the team members who will carry them out. It is an excellent tool for designing, tweaking, and analyzing business processes. Optimizing your business processes using business process modelling may appear to be a gimmick, but it can produce significant results. You may break down your company processes and alter them to assure off-the-charts business efficiency, especially if you use super-efficient approaches like visualization using workflow diagrams.

4.IMPLEMENTATION

GAN Training:

GANs typically work with image data and employ Convolutional Neural Networks, or CNNs as the generator and discriminator models. This could be due to the fact that the first description of the technique was in the field of computer vision and used CNNs and image data, as well as the remarkable progress made in recent years using CNNs more broadly to achieve state-of-the-art results on a suite of computer vision tasks such as object detection and face recognition.

This is a new sort of GAN training that we have created to address several critical issues in the prior image colorization models. It gives the benefits of GAN training while requiring less direct GAN training. Instead, the majority of the training time is spent separately pre-training the generator and discriminator using more straightforward, rapid, and reliable conventional approaches. A fundamental finding here is that more "traditional" approaches often produce the majority of the results required, and that GANs can be used to bridge the realism gap.

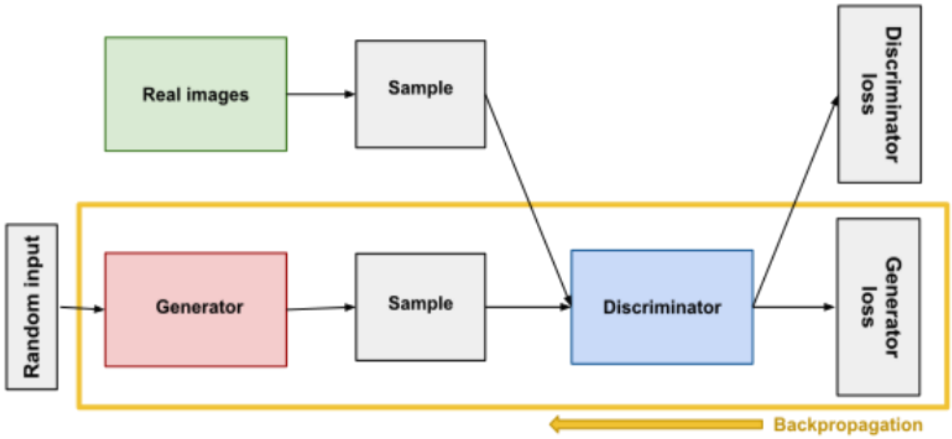

Figure: Pictorial representation of GAN

The generator not only achieves the complete realistic colorization capabilities that used to take days of increasingly resized GAN training, but it also doesn't 33 accumulate nearly as much of the artefacts and other unpleasant baggage of GANs. In fact, depending on the approach, it can almost entirely eradicate glitches and artefacts. This new technology is extremely adaptable and efficient.

5.Results

This is how we were able to achieve such vibrant outcomes with the "artistic" model. However, this comes at a cost right now: the generator's output becomes progressively erratic, and you must experiment with render resolution (render-factor) to get the optimal outcome. However, the renders are still devoid of flaws and far more consistent than I was able to produce with the original Image colorization model.

Figure.1 Normal image colorization VS GAN Image Colorization

The figure. 1 represents the output of the model generated which shows the GAN training can eventually overcome all the glitches and the artefacts being created by the other image colorization methodologies.

Figure.2 Chinese Opium Smokers (1880)

The Figure. 2 represents an old photo taken in the year 1880. This is the famous gang at that time called the Chinese Opium Smokers. The old Grey scale image of the photo is being colorized with much improved skin tones.

Figure. 3 Photo of a Bride (Est. late 1890)

Figure. 3 represents Norwegian Bride, a photo which is estimated to be taken in the late 1890s. With the help of the GAN model the old black and white photo is colorized much efficiently, and the skin tone is improved which makes the photo more realistic.

Further we have tested our model on certain day-to-day images that are captured on our own devices. The results of which are as follows:

Before

After

5.CONCLUSION

In picture-to-image translation, image colorization is both exciting and demanding. Colorization is the transformation of grayscale images into aesthetically appealing color images. So far, the results appear to be realistic. As a result, the model built with convolutional neural networks is working well. This model has improved coloring and processing efficiency. The model we created is more accurate, and its performance has improved. The complexity has also been reduced. It is noted that the grayscale image is efficiently colored. When compared to prior articles, the loss rate is also low.

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