WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Image Colorization Based on Deep Learning

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ABSTRACT

In this paper we have described a method of colorizing the grayscale image into the colored image based on segmented and reference image. The user here just need to provide the colored or grayscale image which will be serve as a reference by the algorithm. we are going to colorize the gray scale image with the help of deep learning techniques. Usually, we colored the image based on the pixels, but in this project we going to identify the objects in the image. Then we colorized the each objects in the image based on U-net Generative Adversarial Network(GANs) which will be trained on over a thousand of images. The network is trained over datasets that are publicly available such as landmark dataset.

Keywords: Generative Adversarial Network(GANs), New Colorization Dataset, Colorization Review

I.Introduction

The colorization of grayscale images has been an active area of research in deep learning for an extensive period of time. In this paper, we will explore the method of colorization using generative adversarial networks (GANs). Colorization is fundamentally an ill posed problem mainly due to the loss of information across dimensions when a color image goes to grayscale version [1]. Colorization was done by matching luminance and texture information between an existing color image and the grayscale image to be colorized.

We decided to experiment with the image colorization of gray-scale images using Generative adversarial network as opposed to traditional regression methods. The general problem of adding color to a grayscale image has no exact and objective solution, since one single grayscale value may correspond to a range of different colors. Since it's known that the gray image loses the information of its real color, and since the gray bandwidth consists of 256 colors only while the real color. It's impossible to find a direct way to get the original color back. The goal of all colorization processes is to replace scalar value saved in each pixel of gray scale image with a vector in three dimensional color space such as red, green, blue vector in the RGB components. Deep learning technology demands high resource. It requires high-performance and more powerful GPUs, large amounts of space to store the data that is used to teach the models. This technology takes more time to trained the data set. It can classify objects and detect the grayscale image.

A. DEEP LEARNING METHODS

The expectation that one or more reference images might contain sufficient color information for satisfactory colorization results is usually not realistic. The evolution of deep learning techniques has enabled training of an artificial neural network with a large number of source images. For colorization, it means automaticallylearning colors that naturally correspond to real objects. The methods yield better results by adding more layers to the neural network and more images to the training set [2].

B. COLORIZATION

After the match of gray segment is found from color square patches that color square patches is used for colorization the whole gray segment of image [3]. Colorization is a technique used to add color to old black and white images.

II. Literature survey

Colorization is basically involving assigning realistic colors to gray scale picture. U-net is also the type of convolutional neural network are specified to designed for the image data.

Jayavarithini [3], proposed the idea of automatic image colorization. Since, they are going to colorize the back and white image with the help of deep learning techniques. They building a deep convolutional neural network(CNN). Its will be trained over the million images. The output of the model is fully dependent on the image it has trained from and requires no human help. They take the input image from different sources like ResNet, Reddit, etc.

Jeff Hwang [4], proposed the idea for image colorization. They explore various network architecture, objectives, color spaces and problem formulations. The finally classified the based on model generates colorized image that are significantly more aesthetically-pleasing that those created

by the based on the line regression-based model.

Matias Richart [5], proposed the idea for colorizing photos. They providing a color version of a given grayscale image. The method does not depend on human input; it is fully automatic. It is based on training set color and corresponding grayscale image. The classifier predicts the color of a pixel based on the gray level of the pixels.

Madhab Raj Joshi [6], proposed the idea of colorization for historical images is very crucial to safeguard the diversity of cultures. Automatic colorization of black and white image has been subjects to extensive research through computer vision and machine learning techniques. The problem of generating a colored photos of ancient, historically black, and white image of the Nepal using deep learning techniques without direct human intervention. They trained neural network is used to predict two a* and b* chroma channels given to grayscale, L channel of test image.

3.Proposed work

Adding realistic color to a grayscale image can improve the photo is realism of image. In proposed system we are using the U-Net Generative Adversarial Networks(GANs) for grayscale image convert to colorized image. In contrast to typical GANs, a U-Net GANs uses a segmentation network as the discriminator. This segmentation network predicts the two classes are real and fake.

3.1.U-Net architecture

U-Net is an architecture for semantic segmentation. It consists the two type of path they are contracting path and expansive path. Its types of convolution neural networks. It has the U shaped architecture. U-Net consist the 3 channel (RGBchannel). It consists repeated application of two 3x3 unpadded convolutions. Contracting path consists the down sampling. In down sampling double the number of feature channel. The expansive path consists the up sampling.

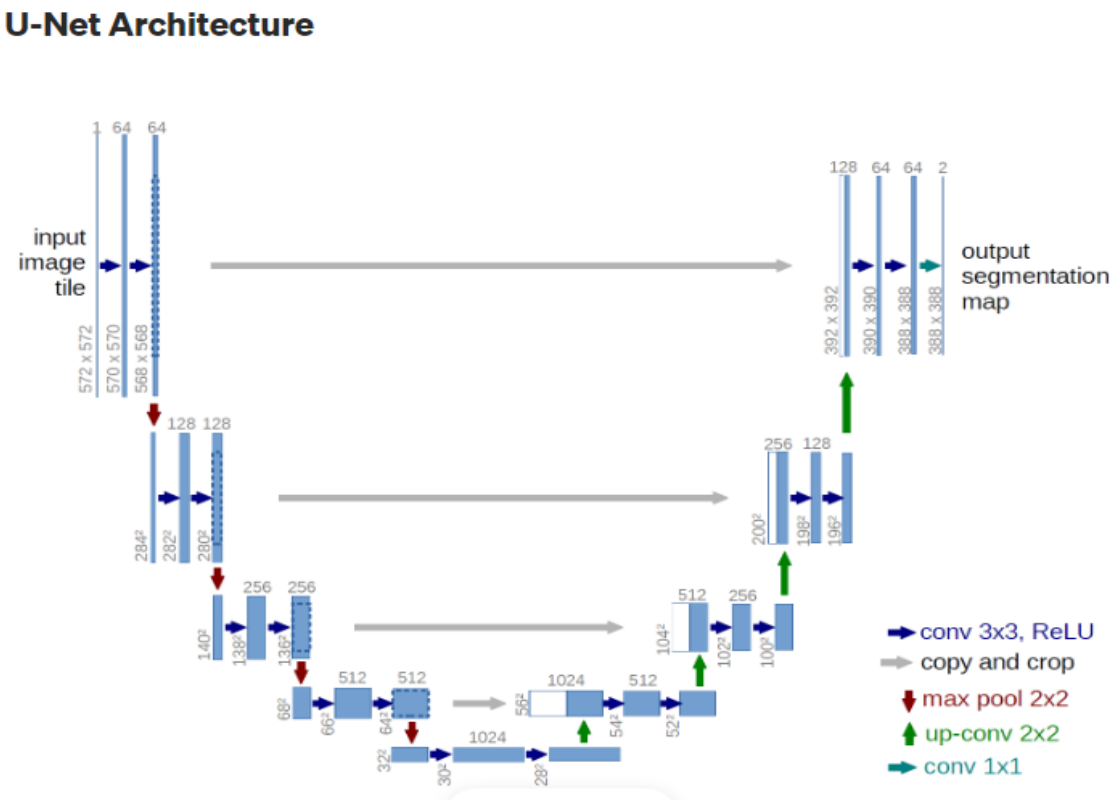

Figure.1 u-net architecture

3.2 Generative Adversarial Networks(GAN)

A generative adversarial network is a machine learning model in which two neural networks compete with each other to become more accurate in their predictions. It composed of two smaller networks called the generator and discriminator. Since colorization is a class of image translation problems, the generator and discriminator are both convolutional neural networks(CNNs). Conditional GANs are the most suitable for the problem of image colorization as they need to condition the network on grayscale input image and generate a color output image. The goal of this two domains such as grayscale to colored. The generator turns noise into an imitation of data to try to trick the discriminator. The discriminator tries to identify the real data from the fakes created by the generator. The generator will take the grayscale image and output an RGB image. Generator will have two types are encoder and decoder structure with the layers placed symmetrically. The encoder will take the grayscale image. The decoder will produce the RGB image an output image.

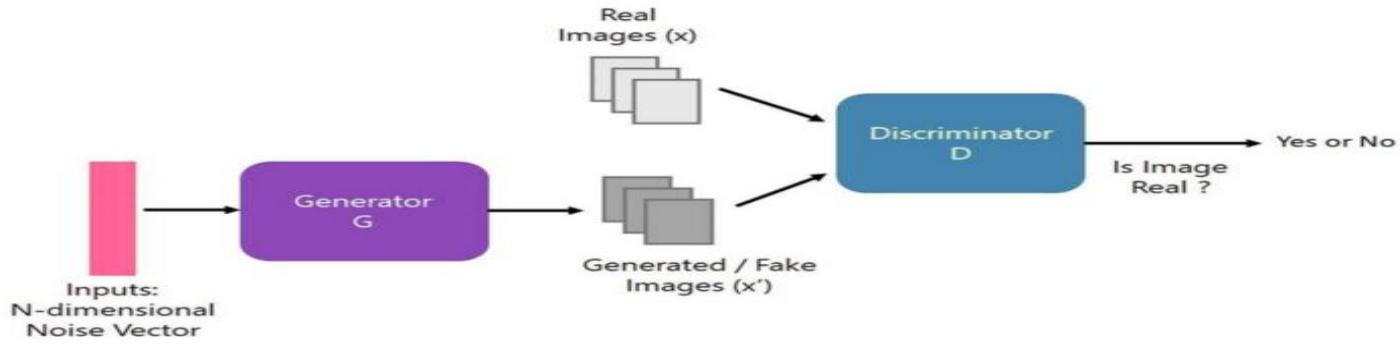

Figure.2 Generative Adversarial Networks

4.Preprocessing

Image preprocessing are the steps taken to formant images before they are used by model training and inference. This includes, but is not limited to resizing, color corrections. Deep learning is used in the domain of digital image processing to solve difficult problems e.g. image colorization, classification and detection. In preprocessing two techniques are smoothing and sharpening.

A. Smoothing

In smoothing we are using the Gaussian filter. smoothing is a digital image processing techniques that reduces and suppresses image noises. Gaussian filtering is used to blur image and remove noise and detail, in one dimension, the Gaussian function is:

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{x^2}{2\sigma^2}}$$

where σ is the standard deviation of the distribution. The distribution is assumed to have a mean of 0.

B. Sharpening

Image sharpening encompasses any enhancement techniques that highlights the edges and fine details of an image. An effect applied to digital images to given them a sharper appearance. sharpening enhances the definition of edges in an image. The dull images are those which are poor at the edges.

5.Feature Extraction

In feature extraction we are used that Radiomics features. Radiomics is simply the extraction of a high number of features for medical images using data characterization algorithms. The typical radiomics analysis includes the evaluation of size, shape and textural features.

6.Classification

In classification we are used the Deep-Recurrent neural network with whale optimization. It's a type of artificial neural network commonly used in speech recognition and natural language processing.

7.Result

In this, paper we using the landmark dataset for colorization. Landmark classification on a very large-scale dataset. This dataset has been recently released to public by google featuring millions of images on thousands of distinct landmarks captured at various locations and uploaded on-line by users over the world. In this dataset evaluate the value by the two categories are peak signal-to-noise ratio(PSNR) and SSIM these two measuring tools that are widely used in image quality assessment.

(a)

(b)

input image convert grayscale colorized image

FIGURE 3 Grayscale result of coloured image

8.Conclusion

In this study, we were able to colorize the grayscale image using the U-Net Generative Adversarial Networks to acceptable visual degree. With the Landmark dataset the model was able to consistently produce better looking image than u-net. Single image colorization is a research problem with critical real life application. Deep learning approaches exceptional success has resulted in rapid growth in deep learning techniques for image colorization. We observe image colorization performance has improved in recent years at the cost of increasing the network complexity. It is clear that the models we used have a hard time learning colorization of large uniform regions such as background sky and walls but fare better when smaller characters are present. The aim of this paper is to make an output image a realistic picture like the input but not necessarily the same as the original. The experimental results shown that the proposed method is better than the existing method. The grayscale image colorization algorithm in term of information richness and contrast and the color overflow is also signification reduced the using grayscale image coloring can also get the good performance of the output.

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