COLORIZATION OF OLD GRAY SCALE IMAGES AND VIDEOS USING DEEP LEARNING*

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COLORIZATION OF OLD GRAY SCALE IMAGES AND VIDEOS USING DEEP LEARNING*

BY

Vaibhav Kant Singh♣
Assistant Professor, Department of Computer Science and Engineering, School of Studies in Engineering and Technology, Guru Ghasidas Vishwavidyalaya, (Central University), Bilaspur, Chhattisgarh, India, vibhu200427@gmail.com

Abstract: In this paper we proposed an automatic approach based on deep neural network to colorize the grayscale images.Today, colorization is usually done by hand in Photoshop and other software. This takes a lot of time and proficiency. We present a convolutional neural network based system using OpenCV that faithfully colorizes black and white photographic images without direct human assistance. We explore various color spaces & image weights. We take a grayscale image as input and attempt to produce a coloring scheme.The goal is to make the output image as realistic as actual background color of image.

Keywords: Deep Learning, CNN

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♣ Correspondence Author: Vaibhav Kant Singh

I. INTRODUCTION

Let's first define the colorization problem in terms of the CIE Lab color space. Like the RGB color space, it is a 3-channel color space, but unlike the RGB color space, color information is encoded only in the a (green-red component) and b (blue yellow component) channels. The L (lightness) channel encodes intensity data only. The grayscale image we want to color can be thought as the L-channel of the image in the Lab color space and our objective to find the a and b components. The Lab image so obtained can be transformed to the RGB color space using standard color space transforms.

II. LITERATURE SURVEY

1. Scribbled base colorization

Colorization using Optimization (Levin et al). This approach to colorizing black and white images was done using shallow machine learning models. The system divided the matrix into clusters of same intensity and colored it accordingly. The color range was provided as an input to the model. This model produced unexpectedly accurate results. The drawback of these models is intensive manual work and professional skills for providing good scribbles.

Fig 1: Scribbled base colorization

2.Deep Learning Based Colorization

Colorful Image Colorization (Zhang et al) This model owes its architecture to Lizuka et al's Let there be color Given the luminance component of an image, the model estimates its b* components and combines them with the input to obtain the final estimate of the colored image. Instead of training a feature extraction branch from scratch, it makes use of an InceptionResNetv2 network (referred to as Inception hereafter) and retrieves an embedding of the gray-scale image from its last layer.

Although only trained to color, the network learns a representation that is surprisingly useful for object classification, detection, and segmentation, performing strongly compared to other self supervised pre-training methods.

Fig 2: Deep learning based colorization

III. PROPOSED WORK

CIE Lab Model

The CIELAB color space (also known as CIE L*a*b* or sometimes abbreviated as simply "Lab" color space) is a color space defined by the International Commission on Illumination (CIE) in 1976. It expresses color as three numerical values, L* for the lightness and a* and b* for the green– red and blue yellow color components.

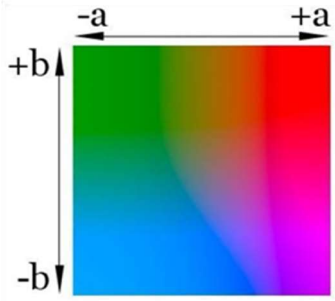


Fig 3: CIE Lab color space

Unlike the RGB color model, Lab color is designed to approximate human vision. It aspires to perceptual uniformity, and its L component closely matches human perception of lightness. The L component is exactly what is used as input of the AI model, that was train to estimate the remained components, “a” and “b”.

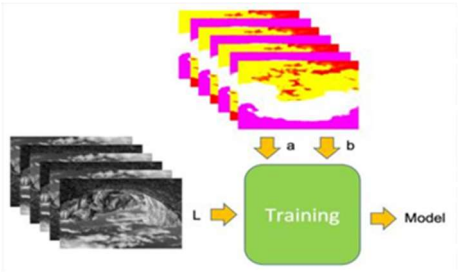
IV. IMPLEMENTATION

Dataset

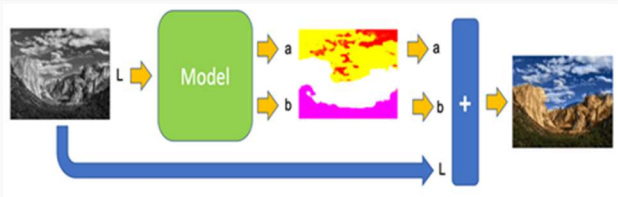
In our project we use Inception_Resnet_v2 dataset because the data set includes various images allowing our model to easily learn the different colors.

The AI (Deep Learning) Process

The Artificial Intelligent (AI) approach is implemented as a feed-forward pass in a CNN (Convolutional Neural Network) at test time and is trained on over a million color images. In other words, millions of color photos were decomposed using Lab model and used as an input feature (“L”) and classification labels (“a” and “b”). For simplicity let’s split in two: “L” and “a+b” as shown in the block diagram:



Having the trained model (that is available publicly), we can use it to colorize a new B&W photo, where this photo will be the input of the model or the component “L”. The output of the model will be the other components “a” and “b”, that once added to the original “L”, will return a full colorized photo as shown in diagram:



V. RESULT AND DISCUSSION

The results shown were created using the algorithm described above with code in JUPYTER NOTEBOOK. Overall, the results came out well.

Input output (57%) original

In this project we used very basic model i.e. sequential model which has not much capacity to colorize the image and also this model does not give guarantee to colorize as actual background color of the image, but it generates a plausible colorization that seems natural to the human eye.

VI. CONCLUSION AND FUTURE WORK

Through our experiments, we have demonstrated the efficacy and potential of using deep convolutional neural networks to colorize black and white image but there are still many improvement on this process. For example we can use VGG-16 which has good capacity to colorize the image.

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