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IMAGE AND VIDEO COLORIZATION

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Abstract: Image and Video colorization is the process of assigning realistic, plausible colors to a gray-scale image/video. Image colorization is simpler than video colorization. In the LAB color scheme, 'L' represent luminance, 'a' and 'b' represents green-red and blue-yellow color components. For Image colorization, we used CNN to build a model which will take a grayscale image as an input and extract the 'L' channel from it, and using it to predict the corresponding 'ab' value. For Video Colorization, this whole method is used for each frame and then combine to get a colorized video. The only problem in Video Colorization is stuttering while combining the frames, we tried to overcome as much as we can.

Index Terms **- Machine Learning, Convolutional Neural Network, Colorization.**

I. Introduction

Today we are in the middle of a digital revolution, we are approaching a better quality of images and higher resolutions. But even in today's date and age, there are few applications that still capture images in grayscale, and the techniques used to convert them to colored images for different purposes are conventional and require a lot of human interaction. Usually, photo editing software like Photoshop and the likes are used to color the images, which is done by a human. Although these techniques are easier, they have a number of drawbacks such as if there are huge amounts of images to be colored then the process is time-consuming. We can't color the videos from this software. [3]

As we know color plays a very important role in our day-to-day life. Without colors, we can't imagine the world. how it would be the world without colors? Image colorization is the process of applying plausible, realistic colors to a grayscale image. It is a highly sought problem among computer vision researchers. As we know videos are nothing but the sequence of frames. So video colorization can be considered as an extension of Image colorization.

II. Literature Review

In the paper titled 'Image Colorization with Deep Convolutional Neural Networks by the author Jeff Hwang, You Zhou[1] have presented a convolutional neural network-based system to color the black-and-white image without human assistance with the help of a statistical learning-driven approach.

In the paper 'Colorful Image Colorization' by Richard Zhang and others[2] had evaluated their algorithm using a "colorization Turing test," asking human participants to choose between a generated and ground truth color image.

In R. Dahl's paper titled 'Automatic Colorization'[3], he used MIT CVCL dataset to train the model which produces two color channels which then concatenated with the grayscale input channel to produce a Luminance (Y), blue–luminance (U), red–luminance (V) YUV image.

In 'ColorNN Book: A Recurrent-Inspired Deep Learning Approach to Consistent Video Colorization'[4], by Divyahans Gupta, Sanjay Kannan uses the temporal context of video frames to enhance the subjective visual quality of their colorings.

Aditya Deshpande in a paper titled 'Learning Large-Scale Automatic Image Colorization'[5] introduced a parametric method for colorization by optimizing a quadratic objective function. Since then parametric methods have been developed to use deep neural networks and convolution neural networks.

In 'Colorization using optimization'[6], by Anat Levin & others present a simple colorization method, which requires an artist only needs to specify the image with a few color scribbles, and the indicated colors are automatically spread in both space and time to produce a colorized image or sequence.

In the paper 'Let there be Color!' by Satoshi Iizuka and others[7] proposed a method based on using global-level and mid-level features to encode the black-and-white image and colorize it with the help of a convolutional neural network.

In K. Simonyan[8], they investigated the effect of the convolutional network depth on its accuracy in the large-scale image recognition setting.

In the paper 'Transferring color to greyscale Images' by Tomihisa Welsh and others[9] introduce a novel approach system that was capable of colorized the input grayscale image by transforming the color from the related referenced images.

III. Existing System

Based on Literature Review, we can classify the existing system as reference image, Scribble-based method, and Convolutional Neural Network.

3.1 Based on Reference Image

Reference Image Grayscale Image Colorized Image

Figure 3.1 Based on Reference Image

Welsh[9] introduce a novel approach system that was capable of colorized the input grayscale image by transforming the color from the related referenced images.

For example, In this system we have to give two inputs, the first input will be the example or reference image and the second input will be the image on which it has to perform a colorization based on the reference image. The model will extract a similar feature and color the grayscale image.

3.2 Scribble-Based Method

Figure 3.2 Scribble - Based Method

Anat Levin & others[6] present a simple colorization method, which requires an artist only needs to specify the image with a few color scribbles, and the indicated colors are automatically spread in both space and time to produce a colorized image or sequence.

This system was used in various animation and cartoon-aimed systems.

3.3 Convolutional Neural Network

K. Simonyan[8], work they investigate the effect of the convolutional network depth on its accuracy in the large-scale image recognition setting.

IV. PROBLEM DEFINITION

Automate the colorization of black & white pictures through a deep neural network. While it is probably difficult to predict exactly the correct colors due to the loss of information (a tulip for example can be of many different colors), the recognition of items within a picture (tree, leaf, type of flower, sky, insect, etc.) should lead to a realistic color. Reconstructing the missing color of a grayscale pixel is here viewed as the problem of automatically selecting the best color among a set of color candidates.

V. METHODOLOGY

5.1 Architecture

5.1.1 Input

Input will be a grayscale image of size 256X256.

5.1.2 Convolutional Layer

The convolutional layer converts the image into numerical values, allowing the neural network to interpret and extract relevant patterns. The feature detector is a two-dimensional (2-D) array of weights, which represents part of the image. The filter size is a 3x3 matrix; this also determines the size of the receptive field. The filter is then applied to an area of the image and a dot product is calculated between the input pixels and the filter. Afterwards, the filter shifts by a stride, repeating the process until the kernel has swept across the entire image. The final output from the series of dot products from the input and the filter is a feature map.

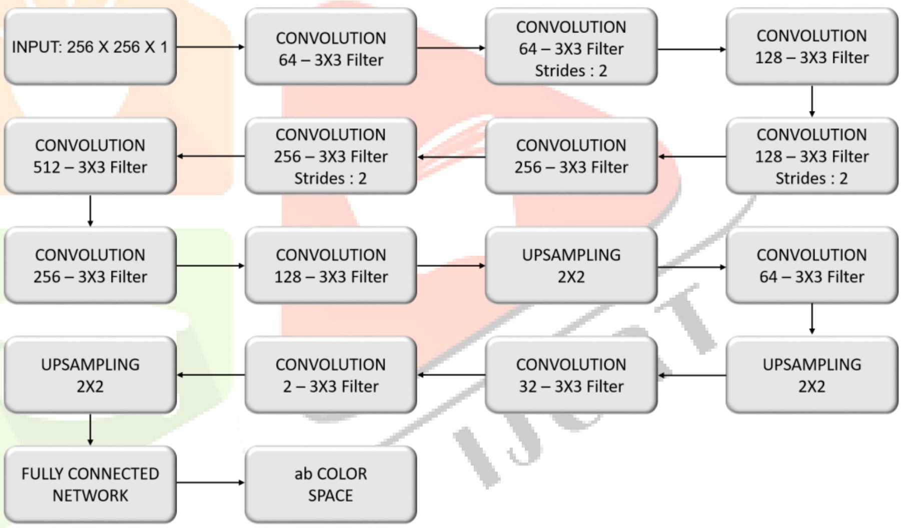

Figure 5.1 Architecture

5.1.3 UpSampling Layer

Upsampling layer restores the size of image

5.1.4 Fully Connected Network

Fully connected network flattens the high-level features that are learned by convolutional layers and combining all the features. It passes the flattened output to the output layer where we use linear activation function to predict ab color space.

5.2 Workflow of Image - Video Colorization

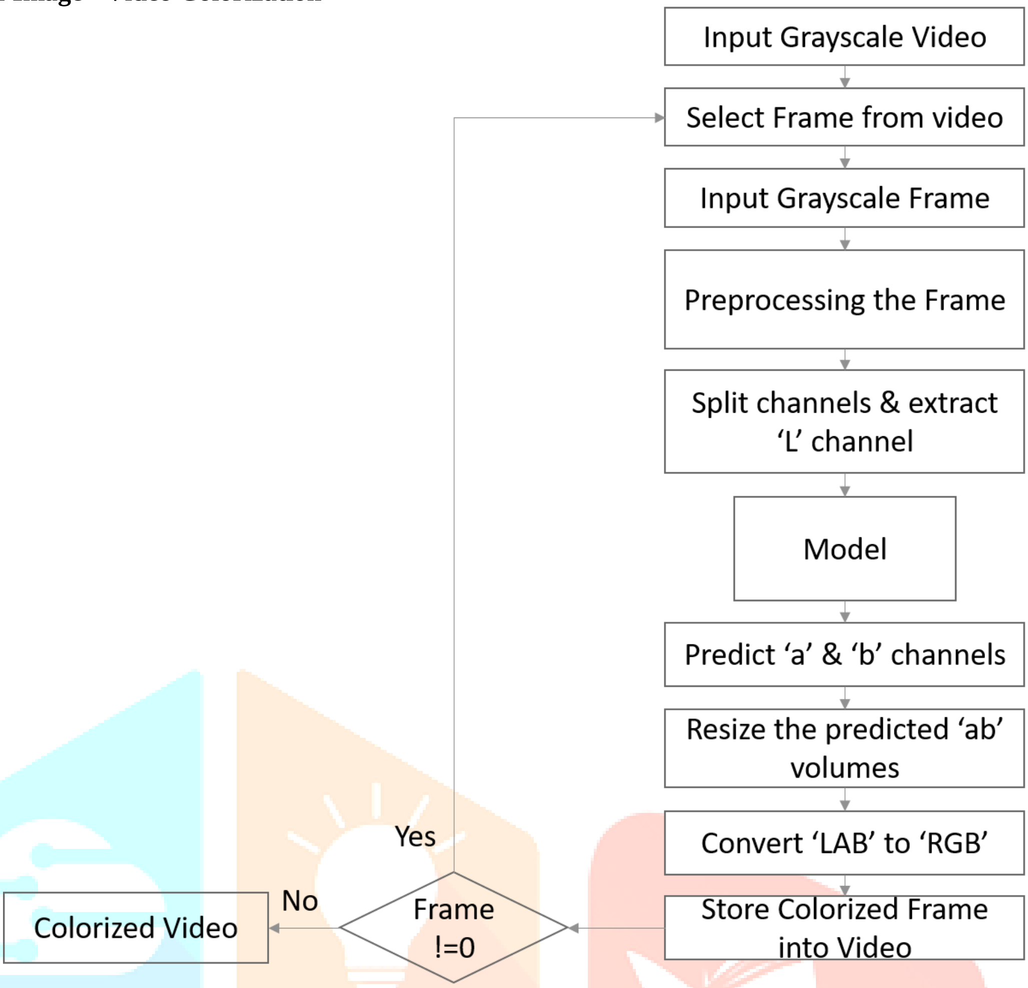

Figure 5.2 Workflow of Video Colorization

- Get the grayscale video.
- The video comprises a series of images displayed in rapid succession. That's why we need to process each frame at a time.
- Scale the pixel intensities to the range [0, 1] and then convert the image from the BGR to LAB color space. LAB color space has three numerical values, L for the luminous, 'a' and 'b' for the green-red and blue-yellow color components. Unlike the RGB color model, LAB color is based on human vision. Resize the Lab image to 224x224.

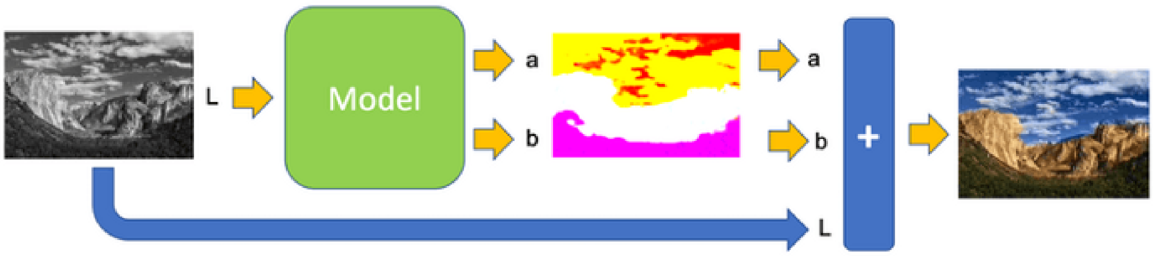

Figure 5.3 Workflow of Image or Frame Colorization

- Split the channels and, Extract L (luminous) channel.
- Then this ‘L’ component is fed to the model to predict corresponding ‘ab’ component, resize it to the same dimensions as our input image then combine it with original ‘L’ to get LAB image.
- Convert LAB image to RGB, then clip any values that fall outside the range [0, 1].
- Store the colorized frames in a subfolder.
- Then combine all frames to get colorized video.

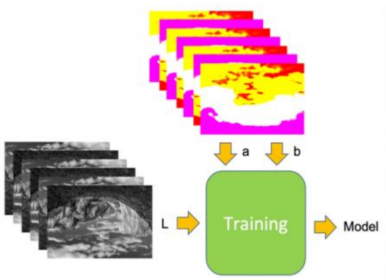

Figure 5.4 Model Overview

VI. RESULTS

After successful training, we tested our model using different images. The results were quite good especially model colorized trees, lake, sky successfully but because of small training dataset there were few limitations of what model can do. Also video colorization is suffering from stuttering and large processing time but we tried to minimize it as much we can.

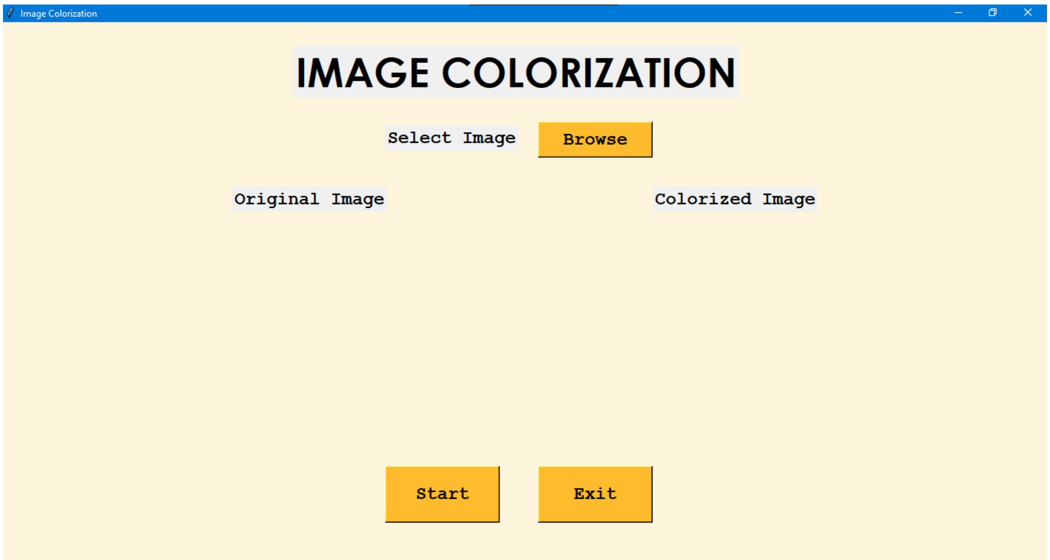

Figure 6.1 GUI for Image Colorization

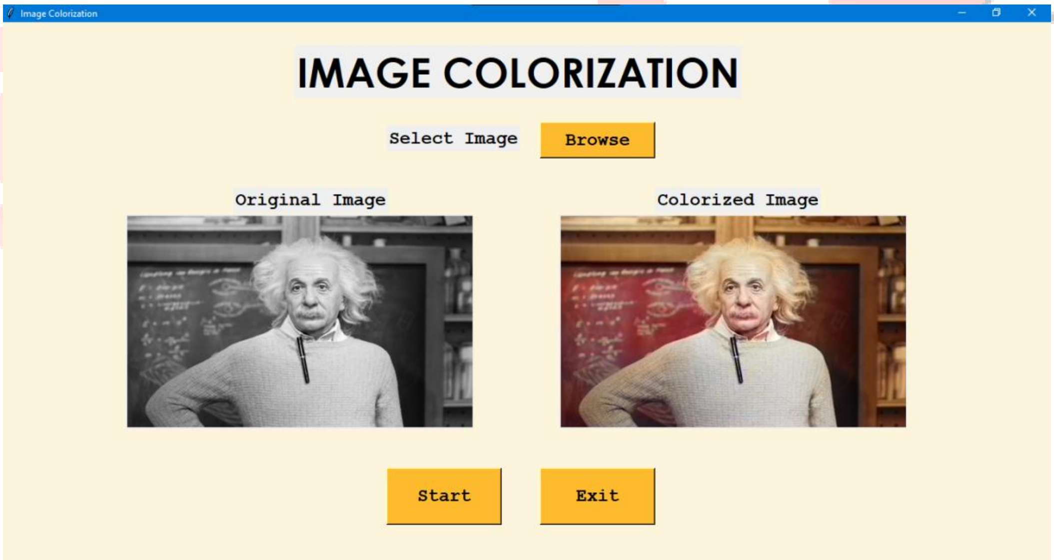

Figure 6.2 Image after Colorization

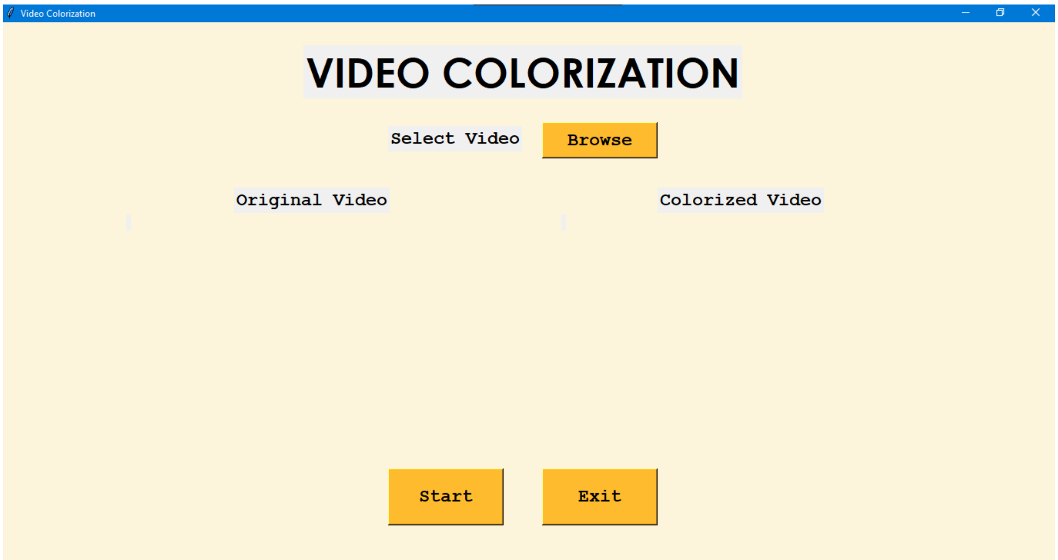

Figure 6.3 GUI for Video Colorization

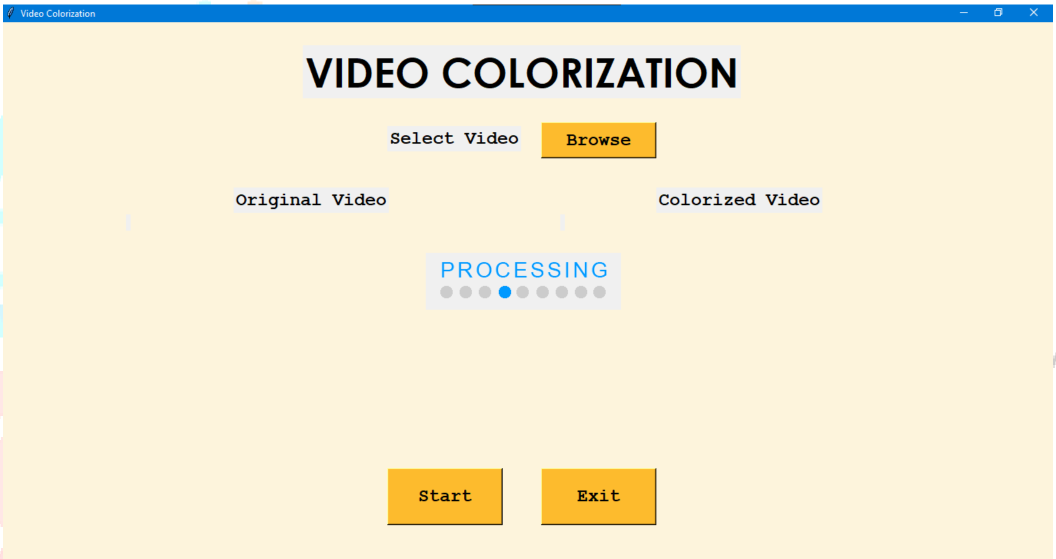

Figure 6.4 GUI for Video Processing

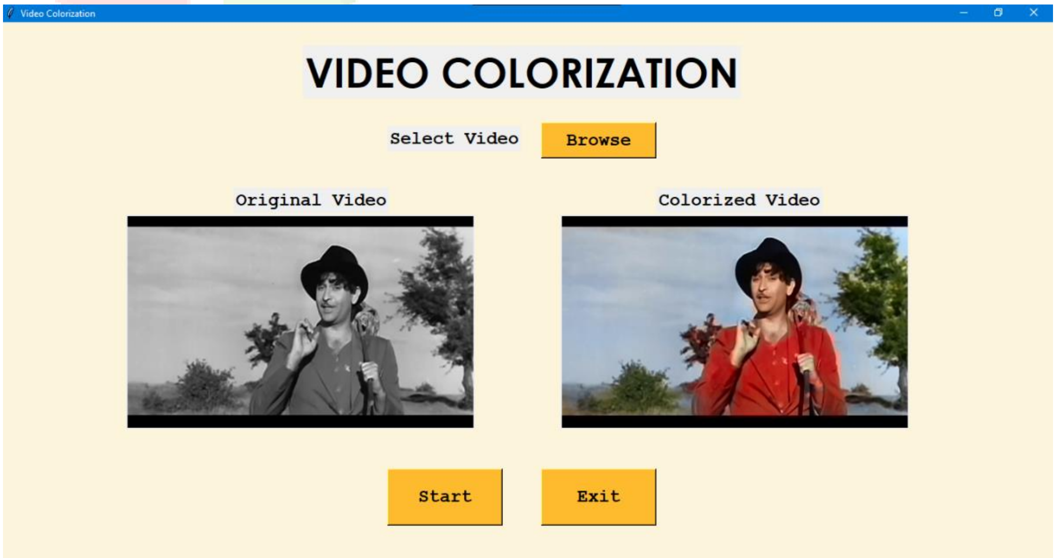

Figure 6.5 Video after Colorization

VII. APPLICATIONS

The application of our project is as follows.

7.1 Astronomy

Hubble telescope doesn't use color film. Its cameras record light from the universe with special electronic detectors. These detectors produce images of the cosmos not in color, but in shades of black and white. The matrix corresponding to the image is sent back to earth station, different filters are applied (red, green and blue) and the equivalent matrices are sent back to the earth station where these are combined to form a color image. This process is tedious and incurs communication cost, hence our system makes this process of colorization automatic and more effective.

Figure 7.1 Astronomy

7.2 Archeology

Images captured few decades ago when there were no color cameras are still in gray scale format and the process to convert them to color requires manual effort. Hence this application is chosen so that the process of colorization can be atomized.

Figure 7.2 Archeology

7.3 Electron Microscopy

Electron microscope is used to observe objects that cannot be seen with naked eye, such as viruses and bacteria. The electron microscope functions by passing an electron beam and focusing it through electromagnets, this beam is either passed through the object or reflected off the surface of the object on fluorescent plate, this electron beam does not transfer color information, and hence the images captured thereby are gray scale. Colors are essential in electron microscopy as it represents vital information. Hence our system would make this colorization process simpler.

Figure 7.3 Electron Microscopy

VIII. CONCLUSION

Video colorization has a variety of applications in both academia and business. This project validates that an end-to-end deep learning architecture could be suitable for some image colorization tasks. In particular, our approach is able to successfully color high-level image components such as the sky, the sea, or forests.

IX. FUTURE SCOPE

The performance of coloring small details is need to be improved to do that we can use large dataset to train our model. Also the mapping between luminance and a*b* components needs an improvement so we can use auto encoders.

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REFERENCES

[1] Jeff Hwang and You Zhou, 2016, "Image Colorization with Deep Convolutional Neural Networks", Stanford_Edu.

[2] Richard Zhang, Phillip Isola, Alexei A. Efros, 2016, "Colorful Image Colorization", Arxiv.

[3] R. Dahl, 2016, "Automatic colorization", Tiny_Clouds.

[4] Divyahans Gupta and Sanjay Kannan, 2016, "ColorNN Book: A Recurrent-Inspired Deep Learning Approach to Consistent Video Colorization", Standard_Edu.

[5] Aditya Deshpande, Jason Rock and David Forsyth, 2016, "Learning Large-Scale Automatic Image Colorization", IEEE.

[6] Anat Levin, 2004, "Colorization using optimization". ACM Journal.

[7] Satoshi Iizuka, 2016, "Let there be Color!" ACM Journal.

[8] Karen Simonyan, Andrew Zisserman, 2015, "Very Deep Convolutional Networks for Large-scale Image Recognition", Arxiv.

[9] Tomihisa Welsh, Michael Ashikhmin and Klaus Mueller, 2002, "Transferring color to greyscale Images". ACM Journal.