CS 595 Project Proposal

Project Title - Colorization of Black and White Photos using Neural Networks

Base Paper - Richard Zhang, Phillip Isola, Alexei A. Efros "Colorful Image Colorization"

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Problem Statement

Coloring greyscale images can be a tedious process with professionals spending months to color an image. Although there have been many services which allow automatic colorization most of these often require user input to assign colors accurately to users. This project aims to fully automize the process of colorizing greyscale images with vibrant and realistic colors. In this project we use Multi-Layer Perceptron and Convolutional Neural Networks to automatically colorize black and white images.

Image colorization assigns a color to each pixel of a target greyscale image. Colorization methods can be roughly divided into 2 categories –

a) Scribble based methods

   These methods require significant efforts from the user to assign accurate colors to greyscale images. This is a very time-consuming method specially for images with fine scale structures.

b) Example based colorization

   Example based colorization methods were later proposed to reduce the burden on users and automate the process. This method transfers color information from a similar reference image to target greyscale image. However, finding similar reference image becomes and obstacle. Thus instead of finding entire images for reference target images are segmented into objects and then most similar image patch/pixel in in a reference image database and then transferring color information from the matched patch/pixel to the target patch/pixel.

Approach

Since CNN are known to have the ability to detect patterns, features and objects from greyscale images we use CNNs to train our model.

A) Data Preprocessing
Before training the model we first resize images to 64X64 pixels and convert out images from RGB color space to L a b colorspace.

B) Activation Funtion
For the activation function we use ReLu as our activation function since it is simple to compute and helps accelerate our model to converge during training.

C) Training and Image Input

- The input for our model was the L* channel and the predictions were the a* and b* channels. Training images are converted to the Lab color space, the L* channel in extracted into an array of integers, the integers in the array represent the Lightness values. These are in the range from 0-100. "ReLu" activation function is used for Convolutional layers and for final layer "tanh" activation function is used.

- The reason tanh function is used is that since ReLu function only produces positive values and the model will not be able to predict the respective blue and green color spectrums, and to fix this "tanh" activation function is used.

- For loss function we use Mean Squared Error.

- For the optimization we use "RMSprop" function.

- To prevent overfitting the model, dropout is integrated between the hidden layers.

D) Data
For training the model we use the Tiny ImageNet 200 dataset. This dataset consists 200 classes of 500 images (64 x 64 pixels) each for a total of 100,000 images. The dataset also includes a test dataset which contains 10,000 images from various classes.

Reference Papers

[1] Zezhou Cheng, , Qingxiong Yang, , Bin Sheng, "**Deep Colorization**"

[2] Ishan Gupta, Rakesh Konda "**Colorizing Grayscale Images**"

[3] Satoshi Iizuka, Edgar Simo-Serra, Hiroshi Ishikawa, "**Let there be Color!: Joint End-to-end Learning of Global and Local Image Priors for Automatic Image Colorization with Simultaneous Classification**"

[4] Richard Zhang, Phillip Isola, Alexei A. Efros, "**Colorful Image Colorization**"