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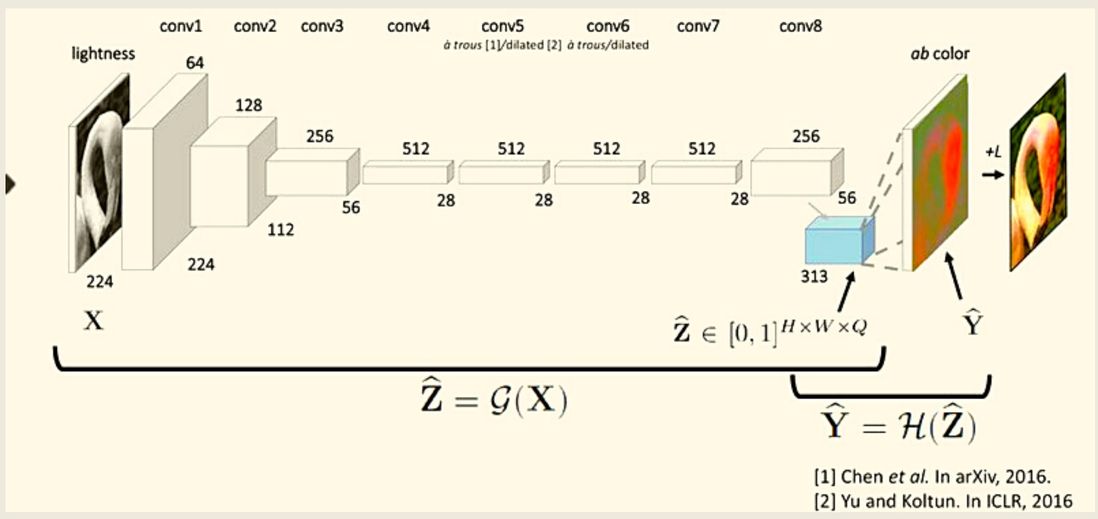
BATCH: 2020 SECTION: BAI-4A

CNN: From B&W to Colorized Photos & Videos

Caffe, a deep learning framework made with expression, speed, and modularity, used along OpenCV for colorization

01. Introduction

Image colorization is the process of taking a grayscale (black and white) image as input and producing a colorized image that accurately depicts the input's semantic colors and tones (for example, an ocean on a clear sunny day must be convincingly "blue" – the model cannot color it "pink").

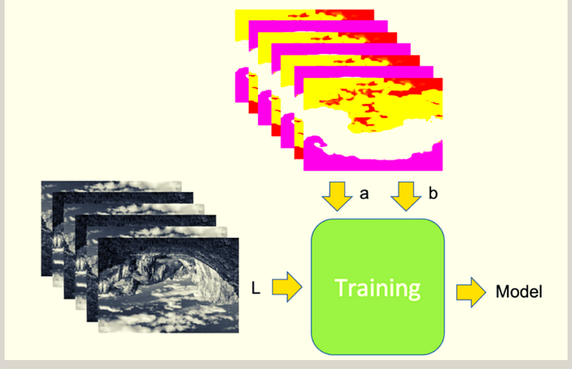


02. Objective

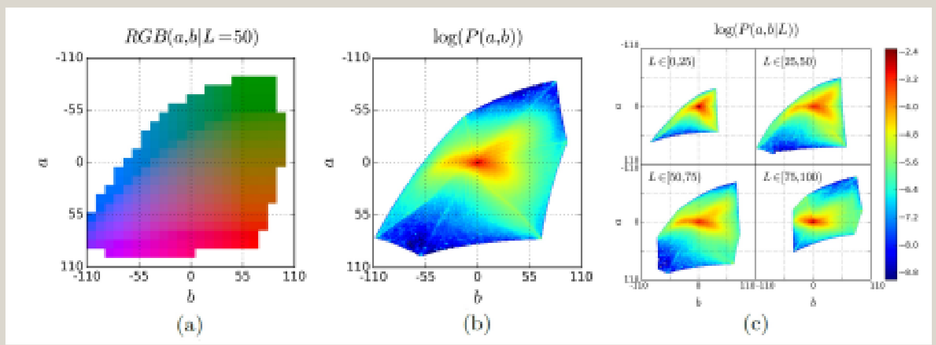
To create a fully automated method for creating realistic colorizations of black-and-white (B&W) photographs and, by extension, videos.

03. Methodology

The system is implemented as a feed-forward pass in a CNN at test time and is trained on over a million color images. We evaluate our algorithm using a "colorization Turing test," asking human participants to choose between a generated and ground truth color image. Our method successfully fools humans on 32% of the trials, significantly higher than previous methods. Moreover, we show that colorization can be a powerful pretext task for self-supervised feature learning, acting as a cross-channel encoder. This approach results in state-of-the-art performance on several feature learning benchmarks.



- Caffe DL Model
- LAB Color Space
- OpenCV



- (a) Quantized ab color space with a grid size of 10. A total of 313 ab pairs are in gamut.
- (b) Empirical probability distribution of ab values, shown in log scale.
- (c) Empirical probability distribution of ab values, conditioned on L, shown in log scale.

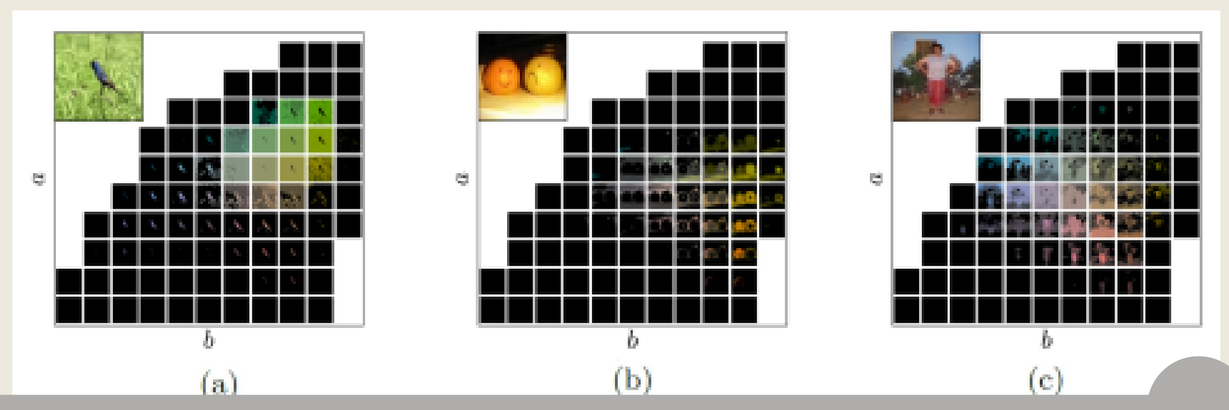
04. Analysis

The Colorizing feature can also be used for correcting faded or otherwise uncorrectable color images. The illustration below shows an original image of singer Bekka Bramlett and saxophonist Deanna Bogart. The photograph was made in club lighting which had only red and blue LEDs which could not be color corrected.
The first solution was to convert the image to monochrome using the Black and White adjustment layer. This made a perfectly useable photograph. Then I colorized it using the Colorize Neural Filter to get desired results.

The original *converted to monochrome* *colorized by CNN*

05. Network Archiecture

The output probability distributions per image. The top-left image is final prediction of our system. The black sub-images are quantized blocks of the ab gamut. High probabilities are shown as higher luminance and are quantized for clarity. (a) Background of bird is predicted to be green or brown. Foreground bird has distribution across blue and red colors. (b) Oranges are predicted to be different colors. (c) The person's shirt and sarong has uncertainty across turqoise/cyan/orange and red/pink/purple colors, respectively. Note that despite the multimodality of the perpixel distributions, the results after taking the annealed-mean are typically spatially consistent.



06. Conclusion

While colorizing images and videos is a specialized form of graphics work, it is also a difficult problem in computer vision. Here we have shown that using a deep neural network (DNN) can produce results that are indistinguishable from real color photos and videos.

Photo

Video

07. References

This project is based on Richard Zhang, Phillip Isola, and Alexei A. Efros' research at the University of California, Berkeley. Colorful Image Colorization. (https://arxiv.org/pdf/1603.08511.pdf).