UNIVERSITY OF ZAGREB
FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING

MASTER THESIS num. 000

Image Colorization Methods

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MASTER THESIS ASSIGNMENT

Student: **Adi Čaušević**

Title: **Image Colorization Methods**

Description:

Greyscale or 8-bit images take up significantly less memory space compared to RGB images that use 24 bits. Sometimes greyscale images are the only thing available, e.g. in the case of historical photographs. Image colorization is a process in which colours are reconstructed using original grayscale image.

Within the thesis study and describe image colorization methods. Special attention should be paid to methods based on soft computing, such as the use of neural networks (today typically deep models). Implementations of at least three different state of the art methods have to be trained and evaluated. The thesis should encompass the source code and other relevant material for recreating the results. The results have to be explained, supported with arguments. The used literature has to be cited and the obtained help acknowledged.

I agree with publishing the final version of the thesis in electronic form on the website of the Faculty of Electrical Engineering and Computing, University of Zagreb, as well as in the public Croatian Digital Thesis Repository of the National and University Library.

Mentor:

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Ovo je zahvala

CONTENTS

1. Introduction

Ever since the advent of photography in the early 19th century people had the urge to add color to photographs. Not long after the invention of the daguerreotype by Louis Daguerre in 1839, the Swiss painter and later photographer Johann Baptist Isenring produced the first colored photographic image by hand-applying pigments to the surface of a monochrome photograph [2]. Although first experiments with color photography date back to the middle of the 19th century hand-coloring monochrome photographs, as seen in figure 1.1, was the easiest method to produce full-color photographic images until the arrival of color film in the mid-20th century. With the beginning of the digital age and the increase of computational power the fascination with coloring images reemerged, but this time the problem was tackled from a computational perspective.

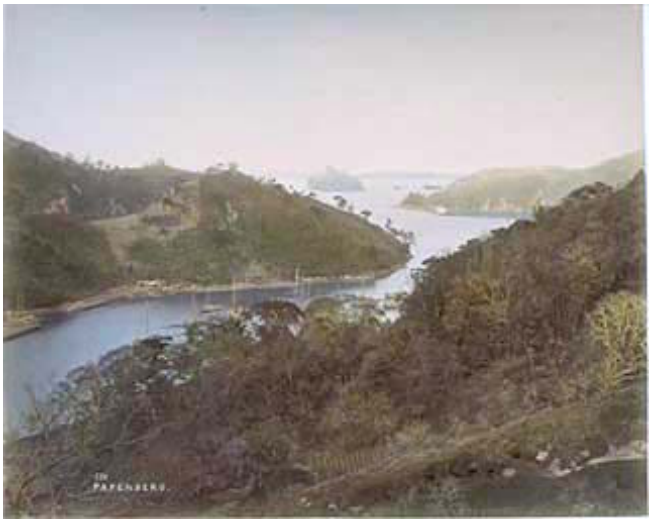

Figure 1.1: Hand-colored photograph by Stillfried & Andersen (made the period between 1862 and 1885)

1.1. Task description

At first sight, the task of automatic colorization might look impossible to accomplish, as information is lost when taking a monochrome photograph. If our goal is to perfectly colorize an image that assumption is valid most of the time because we encounter the problem

of multimodality that is described in section 1.2. If, on the other hand, we are satisfied with a plausible colorization, the task becomes achievable as there is still a lot of semantic information ingrained in the grayscale image.

(a) Original **(b)** Grayscale **(c)** Colorized

Figure 1.2: Colorization example on an image of a stone house

For example, if our colorizer is given the grayscale image in figure 1.2 it can assume that the vegetation surrounding the house is green, while the stone walls are probably some shade of grey. All that information is available no matter that there is no color in the image, but the colorizer should be able to deduce a likely color from the shapes and textures present.

That said the task of colorization can be described as a image-to-image translation problem

- That said - The task of colorization is: get ab color channels from the luminance value of the photo image-to-image translation problem where the domain is the grayscale L channel and codomain are the ab color channels Trying to imagine the probable values for the a and b (color) channels of the CIELab colorspace givent the luminance values of a grayscale image

- It is impossible to perfectly recover the original image as too much information has been lost due to the colorspace - The best the model can do is to offer a plausible colorization - Trying to imagine 2 color dimensions of the lab color space

1.2. Multimodality

Multimodalnost

- Multimodality: Roses are red, violets are grey? There is more to it

1.3. Use Cases

The primary use case of colorization is to add color to old monochrome images taken in an era where colored photography was not yet a viable option. Although people can imagine how the photographed scene looked like when the image was taken, seeing a plausible colorization gives the viewer another perspective to the original image. Automatic colorization

might also be useful in the field of image[1] and video [3] compression as saving only the luminance channel of an image or video (and some color information) reduces the file size with a potentially low impact on the image quality.

1.4. Related work

- Beginning statistical models - Convolutional networks - Generative Adversarial networks - In the last few years novel approaches: Transformers, cINN - Specialized approaches for different use cases

2. Related work

3. Method

3.1. Colorspaces

grayscale RGB LAB color space

3.2. Dataset

- The model is only as good as the dataset

4. Results

5. Conclusion

Conclusion.

6. Conclusion

Conclusion.

BIBLIOGRAPHY

[1] Aroosh Fatima, Wajahat Hussain, and Shahzad Rasool. Grey is the new rgb: How good is gan-based image colorization for image compression? *Multimedia Tools and Applications*, 2021.

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[3] Zhaoqing Pan, Feng Yuan, Jianjun Lei, and Sam Kwong. Video compression coding via colorization: A generative adversarial network (gan)-based approach, 2019.

Image Colorization Methods

Abstract

This is the abstract

Keywords: Keywords.

Naslov

Sažetak

Sažetak na hrvatskom jeziku.

Ključne riječi: Ključne riječi, odvojene zarezima.