Colourising black and white photos with deep learning

Pattern Recognition Project 2020/21

Topics covered

- Problem Introduction
- Literature
- Results
- Future Works

PROBLEM INTRODUCTION

Problem Introduction (1/2)

Objective:

Develop a convolutional neural network that is able to colourise images that were turned monochrome in a manner that will result in images true to the original colours.

Problem Introduction (2/2)

Why it could be an important and interesting problem?

- Possibility to see a colourful world of many years ago by restoring and colourising old photos
- Potentially, the same technique could be applied to old films and videos
- Lower costs and lower requested time for this task (no more human specialists needed) with the possibility of obtaining better results

LITERATURE

Literature (1/2)

From the old days until now (only the most important):

- Semi automatic mathematical model (Pappas and Pitas, 2000): human manually restores sections which are used as reference by regression functions

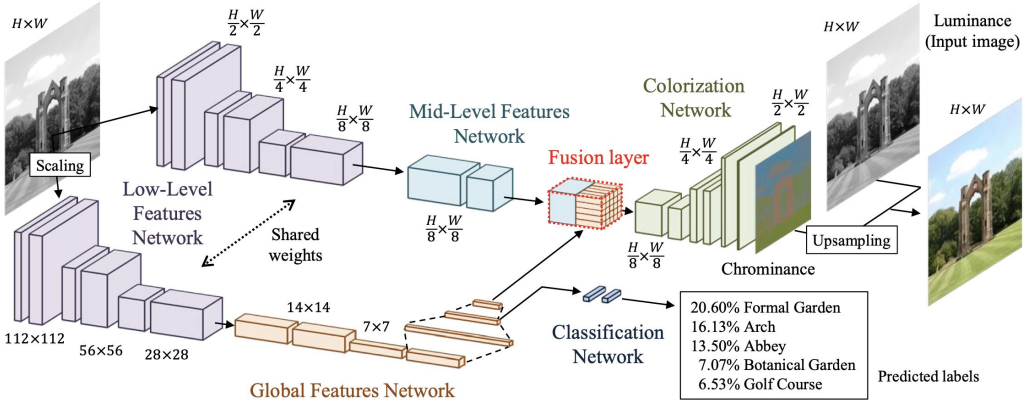
Starting using Deep Learning as a method:

- Un-rebalanced classification loss in a CNN for automatic colorization (Larsson et al, 2016)
- Feed-forward pass in a single-stream CNN with added depth and dilated convolutions using as a loss function a classification loss with rebalanced rare classes (Zhang et al, 2016)
- Fully generalize the colourisation procedure using a Deep Convolutional GAN (Nazeri et al, 2018)

Literature (2/2)

We decided to take as a reference and implement ourselves (with some changes) the model proposed by the paper:

S. Iizuka, E. Simo-Serra, and H. Ishikawa. Let there be color!: Joint end-to-end learning of global and local image priors for automatic image colorization with simultaneous classification. ACM Transactions on Graphics (Proc. of SIGGRAPH 2016), 35(4):110:1–110:11, 2016



Innovative idea: using classification in order to improve the colourisation task and merging global and local features of an image together.

Architecture: two-stream CNN

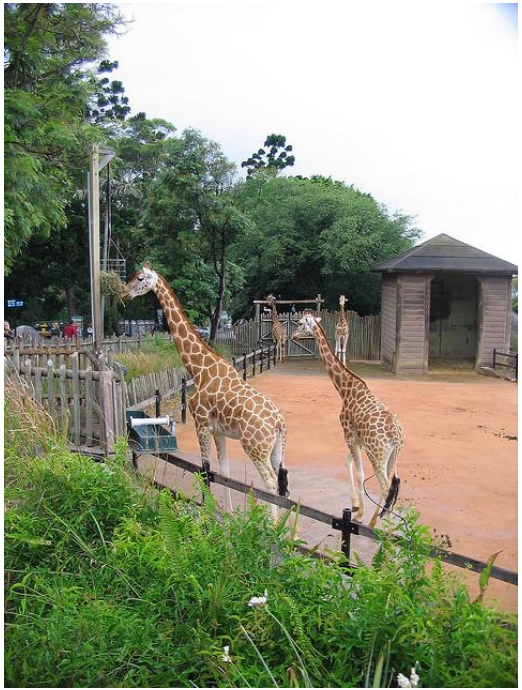
RESULTS

Results (1/14)

Results (2/14)

Results (3/14)

Results (4/14)



Results (5/14)

Results (6/14)

Results (7/14)

Results (8/14)

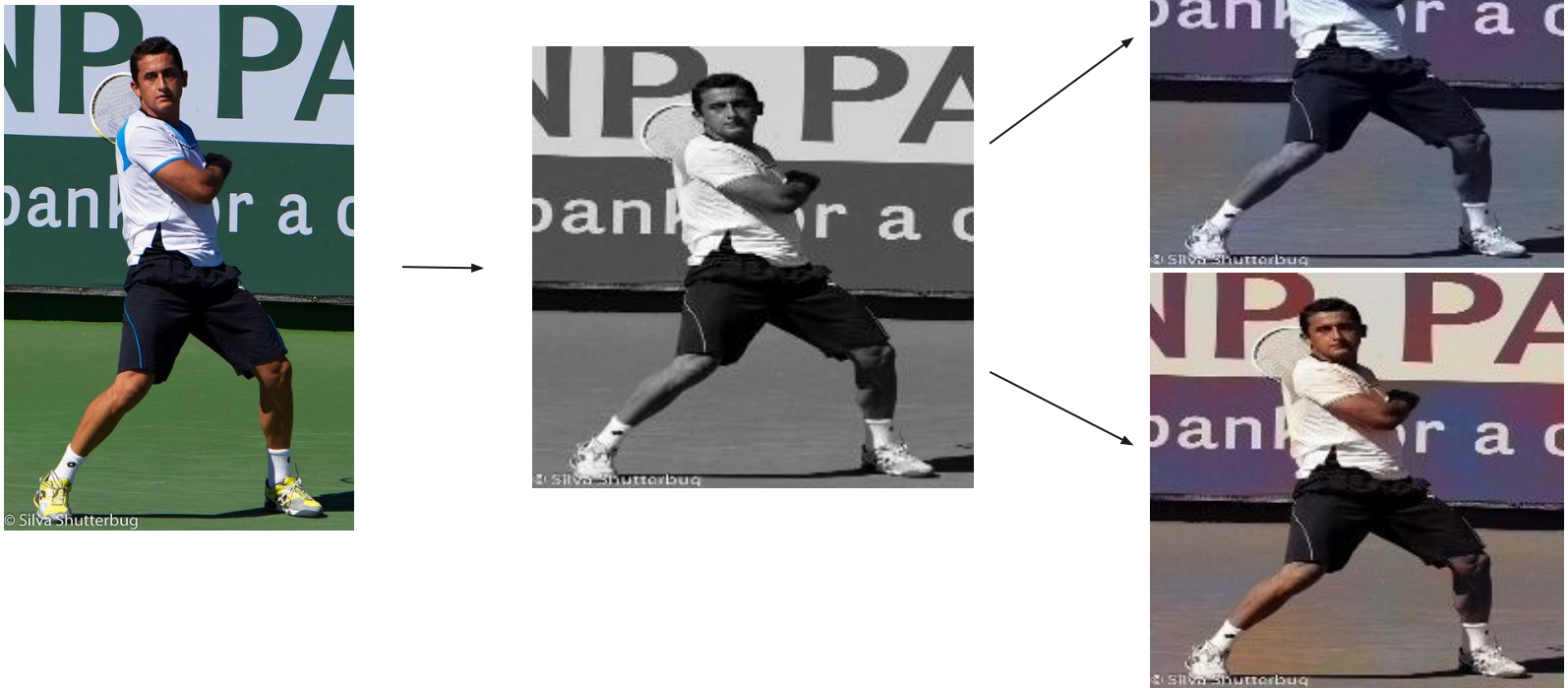
Results (9/14)

Results (10/14)

Results (11/14)

Results (12/14)

Results (13/14)



Results (14/14)

Final thoughts:

- Compared to the original model, trained for 3 weeks on almost 2,500,000 images, ours gives questionable results because trained only for 14 hours on almost 50,000 images (time constraints)

- If trained properly, it will probably give almost the same results

FUTURE WORKS

Future Works (1/2)

- Using keyframes or image sequences for (semi-)automatic video colourisation

- Using metadata such as year that the image was taken or anything else that would help to guess the context in order to improve the output quality

Future Works (2/2)

- Do some research on the use of different colourspaces to represent the images

- Make specialized models, e.g. for colourising images outside, images of people or images of things

Thanks for the attention!

Questions?

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