Diffusion models for image colorization

M2/PFE internship (5-6 months)

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Keywords:	*Deep learning*; *Diffusion models*; *Image colorization*

Subject description

The *PostProdLEAP* research project, in partnership with the Composite Films company based in Paris, is interested in the problem of (semi)-automatically colorizing archive images or videos. Recent methods for colorization are often based on convolutional neural networks trained on large datasets of natural color images [1] (see Figure 1). Generated colors must be semantically accurate, *e.g.*, sky is usually blue, and relevant according the image objects, *e.g.*, avoid color bleeding outside an object or inconsistent colors for the same objects.
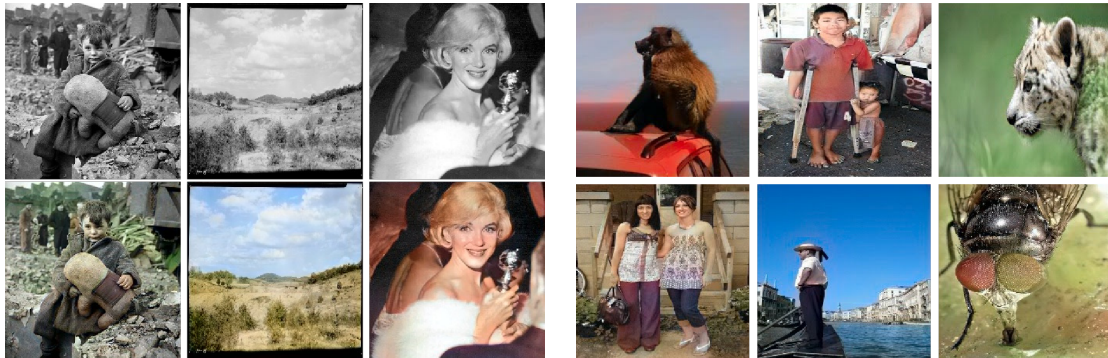

Figure 1: Examples of successfully (left) and failed (right) colorized images [1].

In parallel, these last years, denoising diffusion models have been developed, providing very impressive and consistent results on several image processing and computer vision tasks, especially image generation from text [2, 3] or other images [4] (see Figure 2). These models define a Markov chain of diffusion steps to slowly add random noise to data and then learn to reverse the diffusion process to construct desired data samples from the noise. This generation process is usually conditioned by external prior features (i.e. text embeddings or reference images).

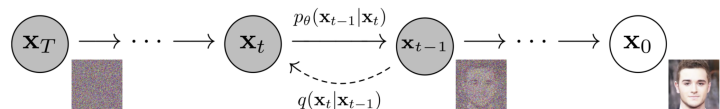Figure 2: Examples of image generation from text [3].

Figure 3: Denoising process in a diffusion model for image generation [2].

The goal of this project is to study the application of diffusion models for the image colorization problem. The internship will be organized according to the following tasks:

1) Literature review on diffusion models and colorization methods;
2) Implementation of a diffusion model adapted for image colorization;
3) Qualitative and quantitative study of the results.

This research internship may lead to scientific publications and be followed by a PhD thesis.

Required profile

Student in Master 2 or last year of engineering school, specialized in computer science, image and/or artificial intelligence. Solid knowledge and experience in image processing, deep learning and programming (Python, TensorFlow/PyTorch, C/C++) are required.

To apply, send a file with CV, cover letter, transcripts, as well as any document likely to strengthen the application (letter of recommendation, etc.). For sending of the requested documents, or for any question on the subject, send an email to the supervisors.

References

[1] P. Vitoria, L. Raad, and C. Ballester. "ChromaGAN: Adversarial picture colorization with semantic class distribution". *WACV* (2020).

[2] J. Ho, A. Jain, and P. Abbeel. "Denoising diffusion probabilistic models". *NeurIPS* (2020).

[3] R. Rombach et al. "High-resolution image synthesis with latent diffusion models". *CVPR* (2022).

[4] C. Saharia et al. "Palette: Image-to-image diffusion models". *SIGGRAPH* (2022).