Image Colorization Using Deep Learning

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Abstract: The idea behind this paper is to develop a fully automatic approach that will generate realistic colorizations of Black & White (B&W) photos and by extension, videos. As explained in the original paper, the authors embraced the underlying uncertainty of the problem by posing it as a classification task using class rebalancing at training time to increase the diversity of colors in the result. The Artificial Intelligent approach is implemented as a feed-forward pass in a CNN ("Convolutional Neural Network") at test time and is trained on over a million color images.

Keywords: Convolutional neural network, Deep learning, Image colorization.

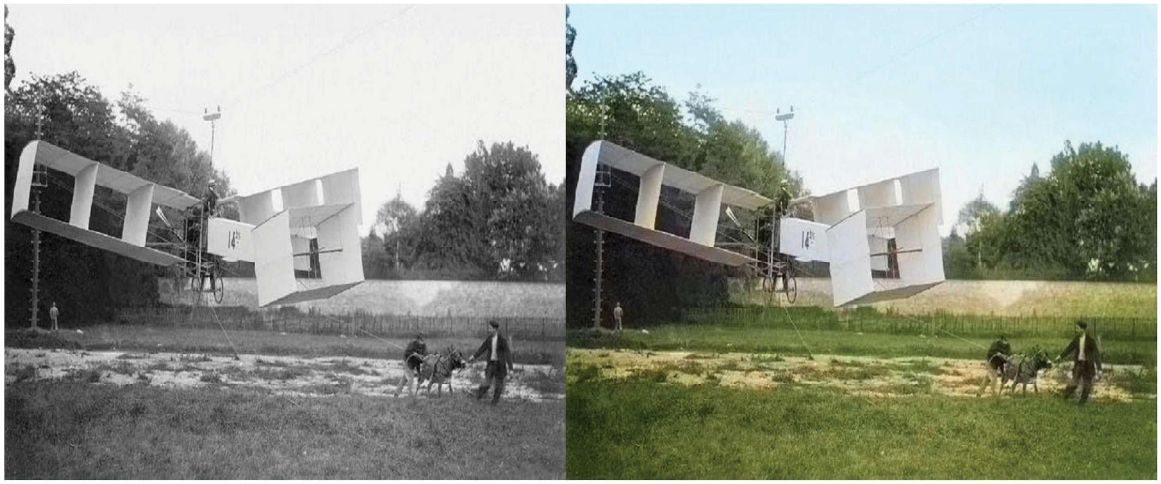
1. Introduction

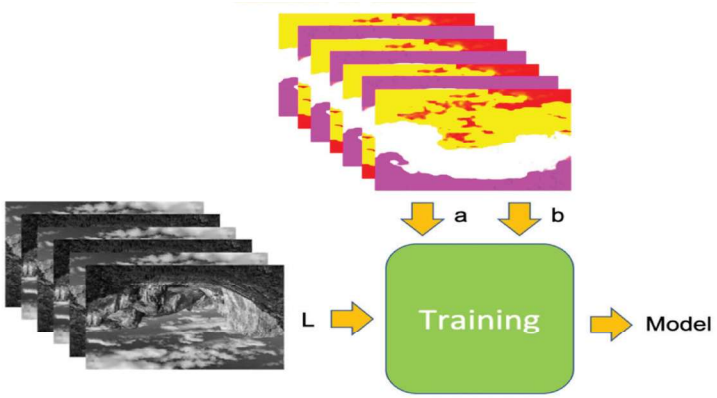
Image colorization is typically performed manually using Photoshop. Many institutions opt for image colorization services to assign colors to grayscale historical images. Additionally, colorization is also utilised for document purposes in the document's image. However, using Photoshop for this purpose requires more energy and time. One salutation to this problem is to see machine learning / deep learning techniques. Today Deep learning has garnered significant interest from researchers in the computer vision and image processing domain. A popular technique in this field is the use of convolutional neural networks

(CNNs), image recognition, image reconstruction, image generation, etc.. Hence We made the decision to work on this topic through the Artificial Intelligence (AI) approach on the basis of CNNs. Our final output is a colored image to create the final color image we will include the L/grey scale image we used for the input. The result will be creating a lab image.

Throughout the history of photography, the act of colorizing images may have been limited to individuals possessing artistic skills. However, thanks to the assistance of Artificial Intelligence, it is now achievable to colorize black and images and videos in white hues with exceptional quality. The primary focus of our paper is to utilise OpenCV, Deep Learning, and Python to achieve the colorization of black and white images. Image colorization involves transforming a grayscale (black and white) input image into a colorized output image that accurately reflects the inherent colors and tones with semantic significance in the original. As an illustration, we present a photograph captured in 1906, showcasing one of the initial tests conducted with the aircraft designed by Santos Dumont “14-bis” in Paris, along with its Version with added color generated using the AI models developed through these techniques.

2. Background & Basic Concepts





As mentioned in the introduction, the AI (Deep Learning) process is employed using a Forward propagation in a Convolutional Neural Network (CNN) during testing. This AI approach is trained on a vast dataset of over a million color images. To clarify, millions of color photographs were decomposed using the Lab model and utilised as input features for the training process. ("L") and classification labels ("a" and "b"). For simplicity let's split in two: "L" and "a+b" as shown in the block diagram.

With the availability of the trained model (publicly accessible), we can employ it to colorize a new black and white image. In this case, the image would serve as the input for the model or the "L" component. The model will generate the remaining components, namely "a" and "b". When these components are added to the original "L", the result will be a complete colorized image.

In summary, a comprehensive dataset comprising 1.3 million photos depicting a wide range of objects and scenes from ImageNet was utilised. Subsequently, a Deep Learning algorithm, specifically a Feed-Forward Convolutional Neural Network (CNN), was employed to generate the final models. This technique draws inspiration from Zhang et al.'s 2016 work, "Colorful Image Colorization." Unlike earlier methods, which relied on manual human annotation and often yielded unsaturated outcomes that lacked "believability" as genuine colorization, the proposed approach provides a more advanced and automated solution

3. Output

Here we have given some images to show our result. Our method takes some input images shown in black and white and they are converted into colorized images.

4. Conclusion and Future Scope

Through this paper, we gained insights into the process of colorizing black and white images using a combination of OpenCV and Deep Learning. Zhang et al. initially introduced the model employed for image colorization in this context in their 2016 paper titled "Colorful Image Colorization." While our results may not be perfect, they demonstrate the potential for automatically infusing color into black and white images and videos. As per Zhang et al., their method successfully deceived humans approximately 32% of the time.

Although this paper is currently limited only to B&W images, we in the future hope to add lots of many features to the paper such as B&W videos to color, upscale low resolution images and videos, remove defects in the photo, all this in a GUI application.

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