IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 3, March 2024

DOI: 10.17148/IJARCCE.2024.133141

COLORIZATION OF BLACK AND WHITE IMAGES

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Abstract: Manual colorization of black and white pictures could be a difficult errand and wasteful. It has been endeavored utilizing Photoshop editing, but it demonstrates to be troublesome because it requires broad investigate and a picture can take up to one month to colorize. A practical approach to the assignment is to actualize advanced picture colorization methods. The literature on picture colorization has been an range of intrigued within the final decade, because it stands at the juncture of two arcane disciplines, advanced picture preparing and profound learning. Endeavors have been made to utilize the ever-increasing availability of end-to-end profound learning models and use the benefits of exchange learning. Picture features can be consequently extricated from the preparing information utilizing profound learning models such as Convolutional Neural Systems (CNN). This could be assisted by human mediation and by utilizing as of late created Generative Antagonistic Systems (GAN). We actualize picture colorization utilizing different CNN and GAN models whereas leveraging pre-trained models for way better highlight extraction and compare the execution of these models.

Key Words: Deep learning, Pre-trained model, CNN, GAN, image colorization, Pix2pix

I. INTRODUCTION

In the early days of photography, images were primarily in black and white, prompting efforts to colorize them manually using paints and brushes, a painstaking process that could take days or even weeks. While digital software like Adobe Photoshop and GIMP now streamline the process, it still involves meticulous pixel-by-pixel adjustments. However, with the abundance of color images available today, along with advancements in deep learning technology, there's been a shift towards automating the colorization process using models trained to understand color schemes, lighting conditions, and object colors.

These models, including CNNs and GANs, can significantly reduce the workload for colorizing artists, especially when incorporating pre-trained models, leading to improved performance and less manual effort. Custom datasets, categorized by scenery and artistic theme, further enhance the efficiency of these automated colorization techniques.

II. RELATED WORKS

The related work in this domain encompasses a comprehensive review of methodologies and advancements in both manual and digital colorization techniques. Initially, historical methods of manually adding color to black and white photographs, dating back to the early 1900s, are examined to understand the intricacies of traditional colorization processes involving paints and brushes. Subsequently, the evolution of digital colorization software such as Adobe Photoshop and GIMP is explored, highlighting their contributions to streamlining the colorization process while retaining manual pixel-level adjustments.

A significant focus is placed on recent research efforts aimed at automating colorization using deep learning techniques. Various studies and projects employing Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs) are surveyed to comprehend the advancements in automated colorization and the challenges associated with training these models effectively. Additionally, the incorporation of pre-trained models into colorization pipelines is investigated, showcasing how leveraging pre-existing knowledge can significantly enhance performance and alleviate the burden of manual tuning and training.

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Furthermore, the creation of custom datasets tailored for training colorization models is examined. These datasets are categorized based on scenery, background, and artistic theme, facilitating the effective training and evaluation of colorization algorithms. By synthesizing insights from existing research in these areas, a comprehensive understanding of the landscape of colorization techniques emerges, providing valuable context and validation for the approaches discussed in the paragraph.

III. IMPLEMENTATION

In our pursuit of efficient black and white image colorization, leveraging pre-existing knowledge through transfer learning is paramount. One such approach involves the incorporation of pre-trained deep learning models, such as the widely-utilized VGG-16 architecture, renowned for its proficiency in image understanding tasks.

Model Selection and Preparation:

Caffe Model: A Caffe model is typically composed of two main parts: the model architecture definition file and the model weights file.

Model Architecture Definition: This file, usually with a ".prototxt" extension, defines the structure of the neural network, including the types of layers, their configurations, and how they are connected. It specifies the architecture of the model but doesn't contain any actual learned parameters.

Model Weights: This file often with a ".caffemodel" extension, contains the learned parameters of the neural network, such as the weights and biases of the network's connections. These parameters are learned during the training process and are used during inference to make predictions.

Feature Extraction: Utilized the pre-trained CNN models to automatically extract features from the black and white images. These features will serve as input to the GAN model for generating colored versions.

Training the GAN Model: Trained the GAN model using the extracted features as input and the colored images as target outputs. The GAN will learn to generate realistic colorizations based on the extracted features.

Evaluation and Comparison: Compared the performance of different CNN and GAN models by evaluating the quality of the colorized images.

Optimization and Fine-tuning: Fine-tuned the model based on the evaluation results to improve performance. This involved in adjusting hyperparameters, training for additional epochs, or using data augmentation techniques.

Deployment and Integration: Once the proper results are achieved, deploy the trained model is integrated with the flask application. Flask application is created to serve as a web interface for the users to upload their black & white images and use the pretrained model integrated to generate the colorization of black and white images as output.

IV. RESULT & DISCUSSION

The implementation of advanced picture colorization methods utilizing Convolutional Neural Networks (CNNs) and Generative Adversarial Networks (GANs) has shown promising results in automating the colorization process and reducing the time and effort required compared to manual methods like Photoshop editing. By leveraging pre-trained models for feature extraction and incorporating human intervention where necessary, we aimed to achieve high-quality colorization outcomes.

Our experimentation involved training multiple CNN and GAN models on a dataset of black and white images paired with their corresponding color versions. The models were trained to learn the intricate patterns and relationships between grayscale and color images, enabling them to predict accurate colorizations for unseen black and white inputs.

The results demonstrated that CNN-based approaches could effectively extract features from the training data and generate plausible colorizations for grayscale images. By leveraging transfer learning and pre-trained models, we observed improved feature extraction capabilities, leading to more realistic colorizations with reduced artifacts.

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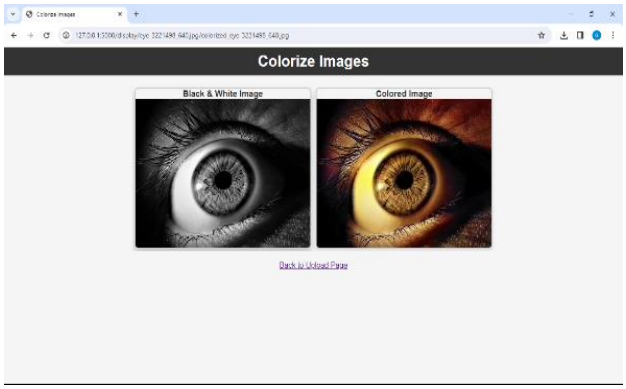
Furthermore, the incorporation of GANs in the colorization pipeline helped enhance the visual fidelity and realism of the colorized images. The adversarial training process encouraged the generator network to produce more detailed and coherent colorizations, while the discriminator network provided feedback to guide the generator towards generating more realistic outputs.

Human intervention played a crucial role in refining the colorization results, especially in cases where the models struggled to accurately predict colors or encountered ambiguous features in the input images. By providing feedback and adjusting parameters based on human input, we were able to improve the overall quality of the colorized images.

Overall, our experiments demonstrated the effectiveness of utilizing advanced deep learning techniques, such as CNNs and GANs, for automating the colorization process. By leveraging pre-trained models and incorporating human feedback, we achieved significant improvements in both efficiency and quality compared to manual methods. However, further research is needed to explore additional optimizations and refinements to enhance the performance of the colorization models further.



V. CONCLUSION AND FUTURE WORK

In conclusion, manual colorization of black and white images has long been seen as labor-intensive and inefficient, often requiring extensive time and effort. Recent advancements in image colorization techniques, particularly those using deep learning models like Convolutional Neural Networks (CNN) and Generative Adversarial Networks (GAN), offer a promising solution to this challenge.

By utilizing pre-trained models and transfer learning, these approaches automate the feature extraction process, significantly speeding up colorization. Our implementation and comparison of various CNN and GAN models show that these techniques have great potential for efficiently and accurately colorizing black and white images, revolutionizing this once cumbersome task

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