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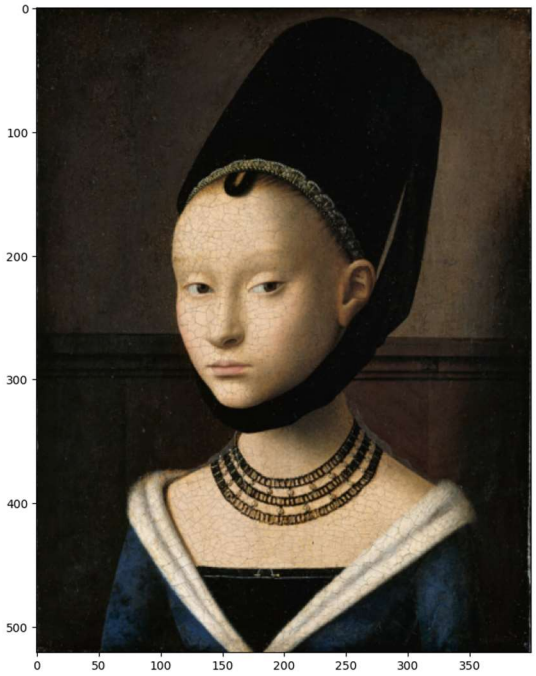
ASSIGNMENT-4

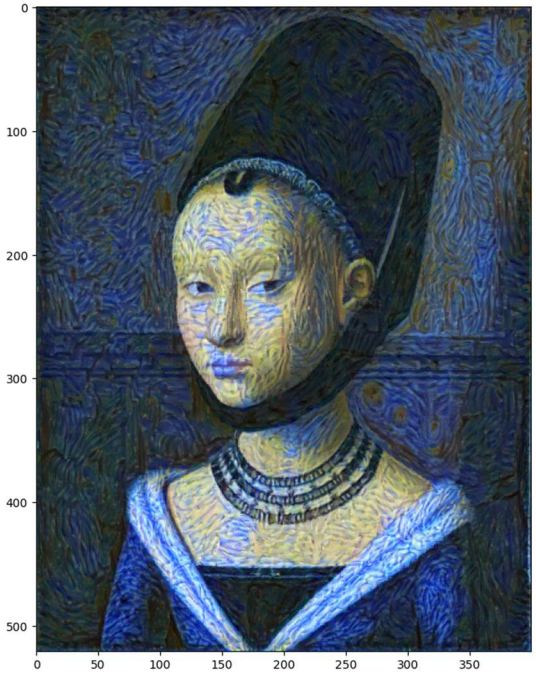
1. Implementation Summary

This assignment implements Style Transfer inspired by the work of Gatys et al. (2016). The technique blends the content of one image with the style of another using a convolutional neural network (VGG19). The content and style features are extracted from various layers of the network, and the final stylized image is generated by optimizing the pixel values of a target image.

Key components of the implementation:

- **Content Representation:** Extracted from layer conv4_2.
- **Style Representation:** Computed using Gram matrices from multiple layers (conv1_1, conv2_1, conv3_1, conv4_1, conv5_1).
- **Loss Function:** Total loss = Content loss (weighted by alpha) + Style loss (weighted by beta).
- **Optimization:** Adam optimizer applied to the target image pixels.





2. Hyperparameter Experiments

- I ran three experiments with 2000 iterations each, varying the weights for content and style:

Experiment	Content Weight (alpha)	Style Weight (beta)	Final Total Loss	Notes
A - Balanced	1e5	1e2	5716.60	Good blend of structure and style
B - More Style	1e5	1e4	118605.97	Strong stylization, less structure
C - More Content	1e3	1e2	1183.83	Preserved original layout the most

- Each experiment used a learning rate of 0.003 and ran for 2000 steps.

3. Visual Results

Each experiment produced a distinct stylized image. The differences are especially noticeable in texture dominance and content preservation.

- **Experiment A:** Balanced result, blending colors and textures moderately while keeping the main structure recognizable.
- **Experiment B:** Highly stylized output with rich textures. Some original content details were lost due to high style emphasis.
- **Experiment C:** Strong content preservation. Output looked very close to the original content image with subtle style influence.

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A Balanced

B More Style

C More Content

4. Observations

- Increasing the **style weight** (beta) results in higher total loss and more visual stylization.
- Lowering the **content weight** (alpha) allows the style features to override structural details.
- The balance between content and style weights is crucial depending on whether the user wants to prioritize recognizability or artistic abstraction.

Notably, Experiment B had a loss value more than 20x higher than A and C, reflecting the model's challenge in merging strong stylistic features.

5. Conclusion

Style Transfer offers a flexible and visually powerful way to mix content and artistic patterns. Through careful tuning of hyperparameters like content and style weights, users can control the artistic depth of the transformation. This project confirms the effectiveness of feature-based style transfer and opens doors for further exploration, such as real-time or GAN-based approaches.