Research Design II

1 SECTION

1.1 TITLE AND AUTHOR INFORMATION

Enhancing Realism in Photo Editing: A Comparative Study of GAN-based Techniques versus Traditional Methods

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1.2 CHOSEN RESEARCH

1.2.1 Description of Theme and Topic Rationale

This dissertation aims to bring more realism to photo editing through the comparison of Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs) with classical image manipulation techniques, i.e., Photoshop. The dissertation discusses how generative artificial intelligence-based models can be leveraged to automate and improve some of the photo-editing tasks, i.e., hair colour change and inpainting an image, with extremely high visual realism. Manual photo editing with Photoshop is traditional and time-consuming, while AI approaches provide efficient, automated, and scalable solutions. AI editing is by no means without its share of problems with regards to computational requirements, ethical issues, and simplicity in dealing with realism.

1.2.2 Positioning and Research Onion

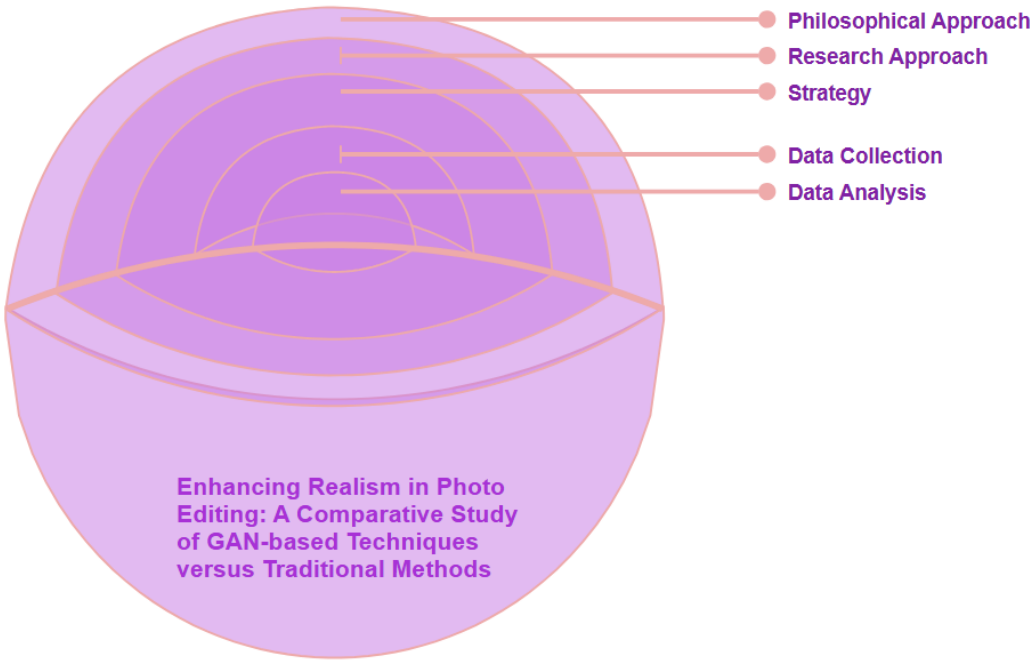
1. **Philosophical Approach:** The ideal approach is adopted in this research, whereas the objective is to explore and compare quantitative findings based on AI-generated images.

2. **Research Approach**: A deductive approach that applies previous hypotheses on GANs, VAEs, and traditional photo editing methods.

3. **Strategy**: A comparative experimental study using AI models trained on a dataset of facial images.

4. **Data Collection**: Empirical evaluation of the quality of images based on metrics such as MSE (Mean Squared Error), SSIM (Structural Similarity Index), and PSNR (Peak Signal-to-Noise Ratio).

5. **Data Analysis**: Quantitative measurement utilising AI-powered outputs, and qualitative evaluation by visual verification.



1.2.3 Background to This Research Theme

Image editing is a critical part of the creative industry, digital marketing, and forensic analysis. AI has revolutionised the field with GANs and VAEs to facilitate high-quality automatic transformations and hence super-resolution, inpainting, and style transfer. Photoshop is a premier software tool, but is time-consuming and skill-dependent, and therefore AI-based automation can be a game-changer. GANs work with two parts: a discriminator and a generator. The generator repeatedly alters the image to make it look more realistic. VAEs work differently, however. They alter image features in a clear way using a concept called latent space. Both techniques have their advantages:

i. GANs have the capability of generating high-resolution images that look aesthetically pleasing but are unstable.

ii. VAEs provide interpretable and structured image transformation but can yield blurry outcomes. The study evaluates AI-editing versus Photoshop based on accuracy, ease, and overall realism.

1.2.4 Hypothesis

The research is built on the following hypothesis:

1. Image editing using GAN is more realistic than with standard Photoshop techniques.
2. VAE-based methods give controlled image alterations in a well-structured form but are less sharp compared to GANs.
3. Both GANs and VAEs can be merged to get a trade-off between realism and organised latent space editing.
4. AI-driven photo editing is significantly quicker than manual Photoshop techniques regarding usability and time.

Previous research, including Karras et al. (2019) on StyleGAN, has demonstrated that AI models can achieve realistic editing with identity preservation. Previous research does not provide a comparison of AI-based editing and standard manual editing techniques, which this study seeks to address.

1.2.5 Research Aim and Purpose Statement

The aim of this research is to:

1. **Compare** how well GAN-based and VAE-based image editing techniques fare compared to normal Photoshop editing.

2. **Analyse** the realism, structure preservation, and efficiency of the AI-driven approaches with respect to their weaknesses and benefits.

3. **Provide** insight into the viability and utility of AI-driven image editing for common use, including digital marketing, fashion, or forensic imaging.