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# A Comparative Analysis of Synthetic Medical X-Ray Image Generation: DALL-E vs. Stable Diffusion

Medical imaging—including X-rays and MRI scans—is crucial for diagnostics and research. However, the development and training of AI diagnostic models are hindered by limited access to large, high-quality datasets due to privacy concerns, high costs, and data scarcity. Synthetic image generation via differentiable programming has emerged as an effective strategy to augment real datasets with diagnostically relevant, high-fidelity images. This approach utilizes gradient optimization to fine-tune image parameters, ensuring that synthetic outputs maintain the essential features of authentic medical images.

In this study, we compare two state-of-the-art generative AI models—DALL-E, a proprietary model developed by OpenAI, and Stable Diffusion, an open-source alternative—for their effectiveness in generating synthetic medical X-ray images. DALL-E is recognized for its ease of use, robust pre-trained capabilities, and high-resolution outputs, while Stable Diffusion provides extensive customization and fine-tuning options that may lead to enhanced performance in specific applications. We apply both models to diverse medical imaging datasets, including those related to COVID-19, tuberculosis, and other respiratory diseases, to significantly expand the size of available datasets.

We assess the impact of synthetic image augmentation by comparing the performance of AI models trained exclusively on real data with those trained on a combination of real and synthetic images. Our evaluation focuses on diagnostic accuracy, image quality, and overall reliability. The results highlight important trade-offs between accessibility, customization, and model performance, offering valuable insights into the practical application of synthetic image generation techniques for improving AI-assisted diagnostics in medical imaging.

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