

INPAINTING MISSING REGIONS IN IMAGES: MEDICAL AND PHOTOGRAPHIC INPAINTING USING DEEP LEARNING

¹Mrs. Pooja K N, ²Nandeesh B H

Assistant Professor Department of Master of Computer Applications, BIET, Davangere-577004.

poojakn531@gmail.com, Davangere, Karnataka, India¹

P.G. Student, Department of Master of Computer Applications, BIET, Davangere-577004.

nandeeshbh09@gmail.com, Davangere, Karnataka, India²

Abstract-Image inpainting aims to reconstruct missing or damaged regions in images while preserving structural consistency and visual realism. In medical imaging, inpainting assists in artifact removal, reconstruction of corrupted scans, and data completion for improved diagnosis. In photographic applications, inpainting is widely used for object removal, image restoration, and content editing. Recent advancements in deep learning, particularly convolutional neural networks and generative adversarial networks, have significantly improved

inpainting performance by modeling contextual and semantic information. This paper presents a deep learning based framework for medical and photographic image inpainting using contextual feature learning and adversarial training. Experimental results demonstrate improved reconstruction quality and structural preservation compared to traditional diffusion based methods. The proposed system supports applications in healthcare imaging, digital restoration, and content editing.

Keywords: Image Inpainting, Medical Imaging, Photographic Restoration, sion

Generative Adversarial Networks, Deep Learning, Computer Vi

I. INTRODUCTION

Image inpainting is the process of filling missing, occluded, or corrupted regions in an image in a visually coherent manner. In medical imaging, incomplete scans due to noise, motion artifacts, or occlusions may hinder accurate diagnosis. In photographic applications, inpainting enables object removal, restoration of old photographs, and creative editing.

Traditional inpainting techniques relied on diffusion based or patch based algorithms, which propagate neighboring pixel information into missing regions. However,

these approaches struggle with large missing areas and complex textures. Recent advancements in deep learning have introduced data-driven inpainting models capable of learning semantic context from large datasets.

Studies published in 2023 and 2024 demonstrate that GAN based inpainting models significantly outperform traditional methods in reconstructing complex textures and structures [1], [2]. Contextual attention mechanisms further improve structural coherence by leveraging surrounding image features [3]. Motivated by these developments, this paper proposes a deep

learning based framework for medical and photographic image inpainting.

II. RELATED WORK

Recent research from 2023–2026 highlights advancements in deep generative inpainting models. In a contextual attention based inpainting model achieved high structural similarity for large missing regions. Similarly, proposed a generative adversarial framework optimized for medical image restoration tasks.

Transformer based inpainting architectures have gained attention for capturing long range dependencies. A 2024 study in demonstrated improved reconstruction performance using attention guided feature fusion. In medical imaging, anatomy aware inpainting techniques were explored in to preserve clinically significant structures.

Evaluation metrics for image reconstruction were discussed in emphasizing the importance of perceptual similarity and structural metrics. Efficient lightweight inpainting models suitable for real time deployment were proposed in focusing on scalability and computational optimization.

These advancements provide a strong foundation for developing robust inpainting systems for both medical and photographic applications.

III. METHODOLOGY

The proposed framework consists of dataset preparation, mask generation, model architecture design, adversarial training, and evaluation.

The dataset includes medical images such as MRI or CT scans and photographic images with artificially generated missing regions. Binary masks are applied to simulate missing areas of varying sizes and shapes.

The model architecture is based on a generative adversarial network consisting of a generator and a discriminator. The generator uses convolutional layers and residual blocks to reconstruct missing regions by leveraging contextual information from surrounding pixels. Contextual attention layers are incorporated to enhance feature propagation across spatial regions.

The discriminator distinguishes between real complete images and inpainted images to ensure realism. The training objective includes reconstruction loss, adversarial loss, and perceptual loss to improve visual quality and structural consistency.

The workflow of the system is described as follows:

- Image Dataset Collection
- Mask Generation and Preprocessing
- Inpainting Model Initialization
- Adversarial Training
- Reconstructed Image Generation
- Performance Evaluation

Evaluation metrics include Peak Signal to Noise Ratio, Structural Similarity Index Measure, and Fréchet Inception Distance for perceptual quality assessment.

IV. RESULTS AND DISCUSSION

Experimental results indicate that GAN based inpainting significantly improves reconstruction quality compared to diffusion based methods. The proposed model effectively reconstructs both small and large missing regions while preserving structural details.

In medical imaging, the system successfully restores corrupted regions without distorting surrounding anatomical structures. In photographic applications, the model generates visually realistic textures and maintains edge continuity.

Quantitative evaluation demonstrates improved PSNR and SSIM values. Visual comparison confirms enhanced perceptual quality and seamless blending between reconstructed and original regions.

However, extremely large missing regions remain challenging, requiring further contextual modeling enhancements.

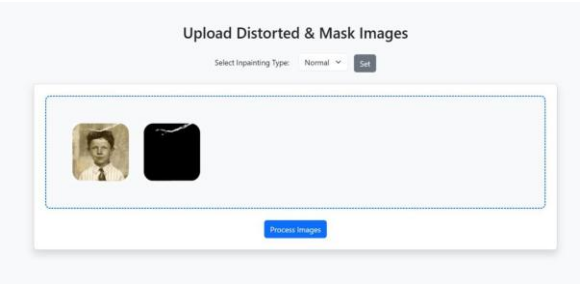


Figure 1:Uploading Distorted Photo and Mask Image for Restoration

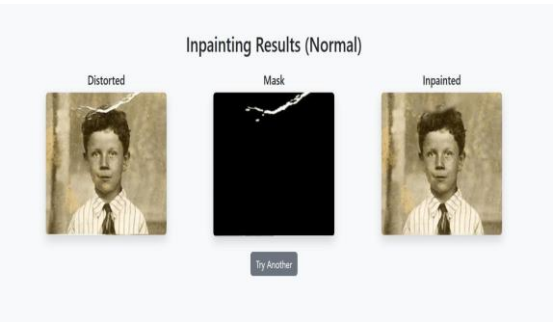


Figure 2:Inpainting results showing distorted photo, mask, and restored output

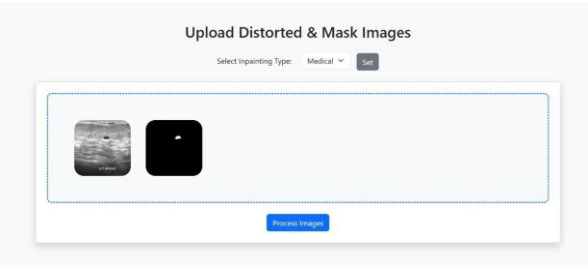


Figure 3:Uploading medical breast cancer image and mask for object removal using Inpainting

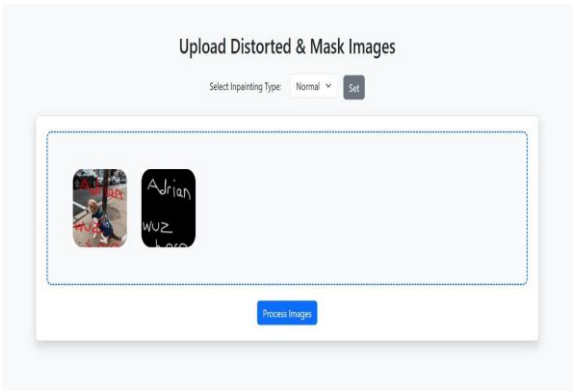


Figure 4:Inpainting results showing distorted photo,mask,and lesion removed output

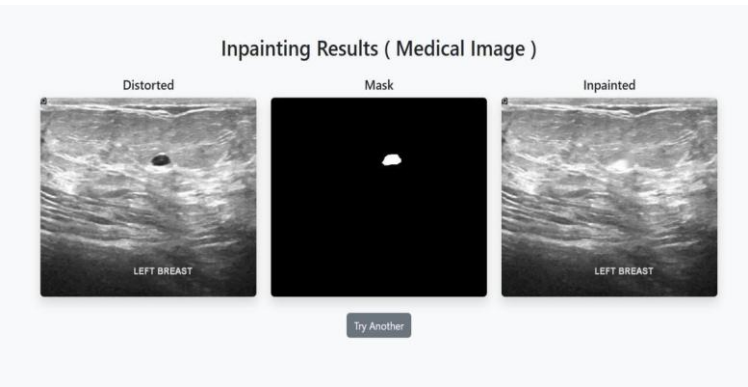


Figure 5:Uploading distorted photo of text and mask image for restoration

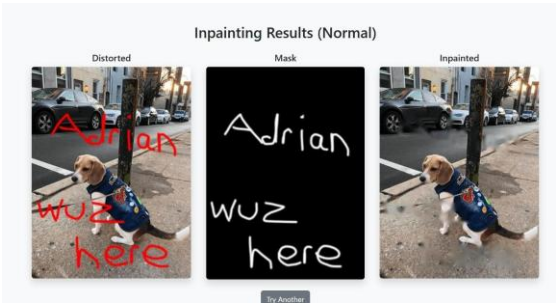


Figure 6: Inpainting results showing distorted photo, mask, and restored output

V. CONCLUSION AND FUTURE WORK

This paper presented a deep learning based image inpainting framework for medical and photographic applications. The proposed GAN based system achieves high quality reconstruction and structural preservation.

Future work includes integrating diffusion based generative models for improved realism, incorporating transformer based architectures for global context modeling, developing anatomy constrained inpainting methods for clinical reliability, and optimizing models for edge device deployment.

VI. REFERENCES

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