Augmenting Naval Ship Images for Viewing Distance using Adobe Generative Fill

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INTRODUCTION

Image augmentation is essential for improving AI model performance, especially in fields with limited or highly specialized datasets. This abstract examines advanced augmentation techniques designed to zoom out images while preserving their integrity. The challenge lies in generating coherent backgrounds while maintaining the structural consistency of the primary subject. Techniques were applied to a diverse pool of 98 images of US Navy ships, aiming to assess the robustness of AI tools capable of accurate image recognition across various zoom levels.

METHODS

The methodology began by exploring several state-of-the-art generative tools, including custom GPTs from OpenAI, Midjourney, Google Vertex AI, Meta LLaMA, and the Generative Fill feature from Adobe Photoshop. Comparative analysis revealed that Photoshop's Generative Fill provided the most realistic and contextually consistent results.

	Cost	Interface Type	Batch API Support	Results Remarks
Chatgpt+	$20/month	Web	No	Unstable
Mid-journey	$10/month	Web	No	Unstable
Vertex AI Studio	$0.04/image	Web	Yes	Unstable
Meta Llama	$0 (self-host)	Web and App	No	Unstable
Photoshop Gen Fill	$19.99/month	App	Yes	Very Stable

Table 1. Comparative Analysis of Gen Tools Used

Before applying generative fill, images were preprocessed using OpenCV to create zoom-out variations with factors of 0.5, 0.25, and 0.125. The images were centered on a white background, producing three distinct datasets for each zoom-out factor. This preprocessing step enhanced the generative model's ability to synthesize naturalistic surroundings.

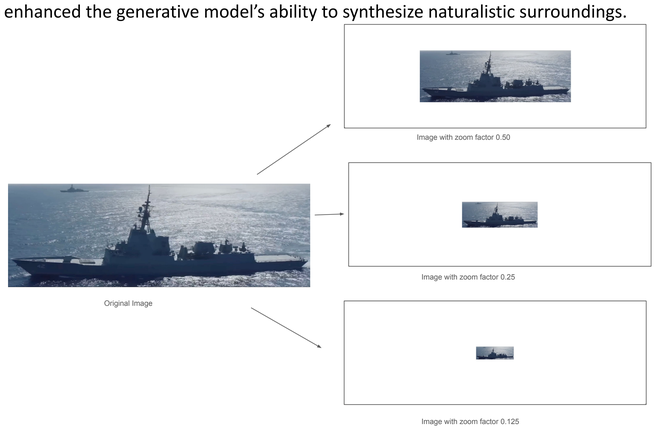

Figure 1. Original image vs. Images zoomed out

Two approaches were implemented for the Generative Fill process: one using the prompt "sea" to guide background generation and another without any prompt for a more neutral fill. Additionally, two operational modes were tested: batch processing for efficiency and manual iteration for precision. These approaches collectively produced three distinct datasets for each zoom-out factor, enabling a comprehensive analysis of augmentation effectiveness.

METHODS

Background Quality: *this refers to the clarity, realism and consistency of the background. Note: Background is the area around the ship - which also include the foreground.*	**Subject Dimension:** This measures how well the AI preserves the proportion and scale of the navy vessel in relation to the zoom level. Consider the OUTLINE	**Subject Integrity:** This evaluates whether key features of the navy vessel (e.g., structure, details, and recognizable components) remain intact after the AI editing.
High: *The background remains highly realistic and consistent with the original image.*	***High****: The vessel maintains its correct proportions.*	***High:*** *The ship retains all critical features.*
Moderate*: The background is mostly intact but has some minor distortions.*	***Moderate:*** *The vessel undergoes minor stretching or compression.*	***Moderate****: Some key features are slightly altered, blurred, or missing.*
Low*: The background is heavily distored or unrealistic*	***Low:*** *The vessel appears highly distorted or improperly scaled.*	***Low****: The vessel has severe distortions or missing critical features.*

Table 2. Outlines the criteria for each classification for each category.

Incomplete Source	Artifacts Present
Check this box when the vessel in the original image is cut off or incomplete	This dimension is used to indicate whether AI hallucinations or artifacts are present in the generated image.

Table 3. Outlines the true or false categories

		**Background Quality:** High **Subject Dimension:** High **Subject Integrity:** High **Incomplete Source:** No **Artifacts Present:** No
		**Background Quality:** Low **Subject Dimension:** High **Subject Integrity:** Low **Incomplete Source:** No **Artifacts Present:** Yes
		**Background Quality:** Low **Subject Dimension:** High **Subject Integrity:** High **Incomplete Source:** Yes **Artifacts Present:** Yes
		**Background Quality:** Medium **Subject Dimension:** High **Subject Integrity:** High **Incomplete Source:** Yes **Artifacts Present:** Yes

Table 4. Shows examples of source, generated, and labels

RESULTS

Labelling is done by an individual by assessing the three categories stated in Table 2, by following the different criteria that apply to each rating between high medium and low, and additionally assessing the criteria in table 3 as being true or false.
Table 4 is an example of how images generated from an image of an Italian destroyer Francesco Mimbelli would be labelled.

Of 784, 532 images have been labelled so far, with 252 left to go. Multiple rater will be utilized in the future and inter-rater reliability metrics will be calculated.

CONCLUSION

This work contributes to the broader field of AI in Practice: Impacts, Risks, and Opportunities by demonstrating the potential of advanced image augmentation to enhance model performance in real-world applications. Improved zoom-out image generation enhances AI's ability to recognize objects in complex, variable-scale scenarios, which is critical for defense, surveillance, and maritime navigation systems. However, this also raises considerations associated with data manipulation and bias. By advancing image augmentation techniques, this research not only enhances model accuracy but also contributes to the ongoing dialogue on responsible AI innovation.

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