LOW-LIGHT IMAGE ENHANCEMENT WITH WAVELET-BASED DIFFUSION MODELS

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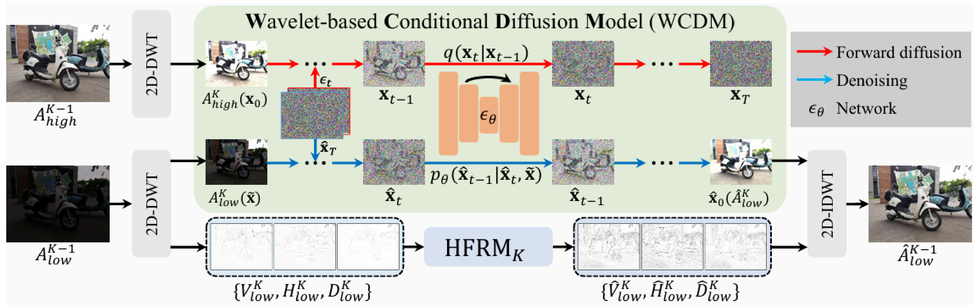
INTRODUCTION

Diffusion models have achieved promising results in image restoration tasks, yet suffer from time and excessive computational resource consumption.

This work proposes a robust and efficient Diffusion-based Low-Light image enhancement approach, dubbed DiffLL incorporating the strength of wavelets.

METHODOLOGY



Wavelet-Based Conditional Diffusion Model (WCDM)

- Leverages the generative ability of diffusion models and the strengths of wavelet transformation.

Forward Diffusion and Denoising

- Both forward diffusion and denoising are performed in the training phase of WCDM to achieve stable denoising and reduce randomness during inference.

High-Frequency Restoration Module (HFRM)

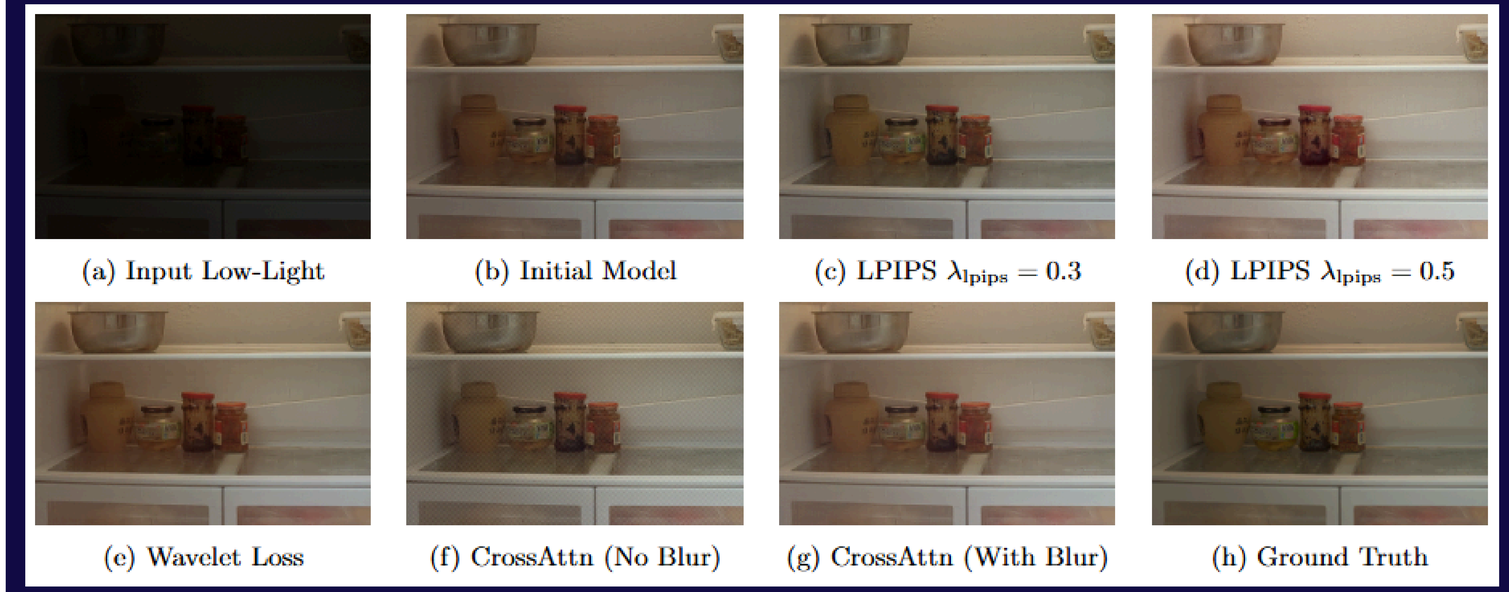
- Utilizes both vertical and horizontal information to complement the diagonal details for local details reconstruction.

ANALYSIS

Metric	Initial Model	LPIPS $\lambda_{lpips} = 0.3$	LPIPS $\lambda_{lpips} = 0.5$	Wavelet Loss	Cross Attention (No Blur)	Cross Attention (With Blur)
PSNR (dB)	25.45	25.59	**25.63**	24.93	23.32	20.40
SSIM	0.87	0.87	**0.87**	0.87	0.59	0.32

Multiple ideas were implemented over the initial model to better implementation such as addition of loss components (LPIPS-based and wavelet regularization loss) and cross attention layers.

RESULTS



The LPIPS-based perceptual loss displays the best results among the different implementations.

CONCLUSION

Experimental results show that this method achieves state-of-the art performance on both distortion metrics and perceptual quality while offering noticeable speed up as compared to previously used methods for this task.