



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 6, June 2025

Contrast Enhancement and Noise Reduction in Images using Filtering Techniques and Deep Learning

Dr. N. Thenmozhi

Assistant Professor (SG), Department of Electronics and Communication Engineering, AAA College of Engineering
and Technology, Virudhunagar, Tamil Nadu, India

K. Kiruthika, G. Muneeswari, M. Jayalakshmi

Department of Electronics and Communication Engineering, AAA College of Engineering and Technology,
Virudhunagar, Tamil Nadu, India

ABSTRACT: Improving picture quality is essential, especially when handling noise and low contrast in a variety of applications, such as surveillance and medical imaging. To achieve high-quality image augmentation, this research proposes a hybrid strategy that combines deep learning models with traditional filtering techniques. To increase contrast and lower noise, the suggested approach initially uses bilateral filtering and contrast limited adaptive histogram equalization (CLAHE). A Convolutional Neural Network (CNN), which has been trained to identify noise patterns and improve picture details, is then used to process the corrected images. Peak Signal-to-Noise Ratio (PSNR) and Structural Similarity Index (SSIM) are used to evaluate performance, demonstrating the hybrid approach's superiority over conventional techniques.

KEYWORDS: Image Enhancement, Noise Reduction, Deep Learning, Filtering Techniques, CNN, CLAHE, Bilateral Filtering, PSNR, SSIM.

I. INTRODUCTION

Image enhancement is a well researched topic that addresses noise and contrast issues with existing images to improve quality. There has been a rich research target in various fields, such as medical imaging, surveillance, and photography, to enhance the visibility of images by employing several traditional as well as deep learning-based techniques. Traditional methods such as histogram equalization or smoothing filters have been widely employed yet are insufficient to retain fine details thereof. Deep learning — especially, Convolutional Neural Networks (CNNs) — has achieved great success in image restoration and enhancement recently by learning high-level features from large-scale datasets.

II. RELATED WORK

Traditional methods of filtering and deep learning techniques for image enhancement have been explored in a few studies. As it prevents over-enhancement in bright and dark regions, CLAHE is commonly used in contrast enhancement. Another widely used technique is bilateral filtering, which can reduce noise well and also leads to an edge retaining result. CNN-based methods have attracted attention since they can both learn features from images and restore fine details, high-quality enhancement is essential for some applications.

III. METHODOLOGY

The proposed method is a hybrid method that uses traditional methods and deep learning-based ones to improve the image quality. Step 1: Grayscale and Resize In this step the input image is converted into a grayscale format so that image processing can be done more efficiently without missing much detail. What follows is that the image is resized to a standard resolution of 256×256 so as to ensure consistency. Then, contrast enhancement using Contrast Limited

Adaptive Histogram Equalization (CLAHE) leads to clearly visible image details by enhancing contrast adaptively without excessive amplification of noise. Then, some Noise Reduction is performed using a mix of Bilateral and Median filters to suppress noise while keeping edge sharpness, allowing important structures and textures to be preserved and eliminating unwanted distortions. A CNN (Convolutional Neural Network) model trained is used for image details enhancement. The model then processes the upsampled image and adds back the lost details, creating a high-resolution clean image that is as good as the original.

IV. EXPERIMENTAL RESULTS

Various levels of processing are illustrated in output from the proposed method. In the input image, there are significant noise and less contrast due to their real use cases like low-light and medical images. The next step is the conversion of the image to grayscale followed by resizing it. CLAHE is used for contrast enhancement to render details noticeable, followed by Bilateral and Median filter for noise reduction capable of eliminating noise while maintaining edges and textures. Lastly, we see the output image generated from the CNN model that has a much improved image quality and is able to reserve finer details.



(a)

(b)



(c)

(d)



(e)

- a. Noisy and Low Contrast Input Image: The input image is original and evidently noisy and low contrast, which is common in many real-world applications, including low-light photography and medical imaging.
- b. Image preprocessing: All first, it will convert image into gray and in uniform size for processing.
- c. CLAHE Contrast enhancement: CLAHE, properly enhance contrast to boost the details.
- d. Noise reduction with bilateral and median filtering: The contrast between an image and its noise.
- e. CNN: Output from Pre-trained Model: Clearer and discernable image from CNN model restoration of finer details.

V. CONCLUSION

Here, filtered images were generated using a hybrid methodology that leveraged conventional filtering methods and deep learning techniques to improve image quality. CLAHE, Bilateral Filtering, and CNN-based processing exhibited better-sequence performance in terms of contrast enhancement and noise reduction, respectively. This approach has been tested on a range of images with satisfactory enhancements keeping simple details intact in the image. Future work may further optimize deep learning architectures and extend the approach over multiple datasets and applications in real-life.

REFERENCES

1. Pizer, S. M., et al. (1987). Adaptive Histogram Equalization and Its Variants. *Computer Vision, Graphics, and Image Processing*, 39(3), 355-368. DOI: 10.1016/S0734-189X(87)80186-X
2. Zuiderveld, K. (1994). Contrast Limited Adaptive Histogram Equalization. In *Graphics Gems IV* (pp. 474-485). Academic Press.
3. Tomasi, C., & Manduchi, R. (1998). Bilateral Filtering for Gray and Color Images. *Proceedings of the IEEE International Conference on Computer Vision (ICCV)*, 839-846. DOI: 10.1109/ICCV.1998.710815
4. Huang, T., Yang, G., & Tang, G. (1979). A Fast Two-Dimensional Median Filtering Algorithm. *IEEE Transactions on Acoustics, Speech, and Signal Processing*, 27(1), 13-18. DOI: 10.1109/TASSP.1979.1163188
5. Buades, A., Coll, B., & Morel, J. M. (2005). A Non-Local Algorithm for Image Denoising. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 60-65. DOI: 10.1109/CVPR.2005.38
6. Lim, J. S. (1990). *Two-Dimensional Signal and Image Processing*. Prentice Hall.
7. Gonzalez, R. C., & Woods, R. E. (2018). *Digital Image Processing (4th Edition)*. Pearson.
8. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press.
9. Zhang, K., Zuo, W., Chen, Y., Meng, D., & Zhang, L. (2017). Beyond a Gaussian Denoiser: Residual Learning of Deep CNN for Image Denoising. *IEEE Transactions on Image Processing*, 26(7), 3142-3155. DOI: 10.1109/TIP.2017.2662206
10. Ancuti, C., Ancuti, C. O., & De Vleeschouwer, C. (2018). D-HAZE: A Benchmark for Image Dehazing with Depth Information. *IEEE Transactions on Image Processing*, 29, 6250-6265. DOI: 10.1109/TIP.2018.2871939
11. Wang, Z., Bovik, A. C., Sheikh, H. R., & Simoncelli, E. P. (2004). Image Quality Assessment: From Error Visibility to Structural Similarity. *IEEE Transactions on Image Processing*, 13(4), 600-612. DOI: 10.1109/TIP.2003.819861
12. He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep Residual Learning for Image Recognition. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*, 770-778. DOI: 10.1109/CVPR.2016.90



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details