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Enhancement of Image Taken Under Low Light Ambiance Using Convolutional Neural Network

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1.ABSTRACT

A variety of computer vision applications can be negatively impacted by environmental circumstances like haze and fog, which can severely reduce the visual quality of images and movies. This project offers a novel CNN-based method for dehazing images and videos. The suggested technique adaptably improves the dehazing process by taking advantage of the gradient information and intrinsic structure found in hazy images and movies. Convolutional filters are dynamically adjusted by the CNN in response to local gradient fluctuations in the image and video. The algorithm's capacity to adapt allows it to distinguish between regions with differing levels of haziness, which improves dehazing performance. The technique is incorporated into a global and local atmospheric light estimation-based image and video restoration framework. Using this image and video dehazing technique, the long-distance fog environment in the image and video will be eliminated.

Keywords:
Feature Learning, Transmission Estimation, Atmospheric Light Estimation, End-to-End Training, Adaptability, Efficiency, Quality Improvement

2.INTRODUCTION

Convolutional Neural Networks (CNNs) have emerged as a viable solution for the problem of hazy or foggy circumstances in outdoor photos for single image dehazing. Photographic vision, contrast, and color are severely compromised by haze, which is a result of air particles scattering and absorbing light. This lowers the visual quality and makes it harder to discern scene details. Conventional techniques for eliminating haze frequently depend on manually created features and tangible models, which might not be able to handle intricate scenarios and variations in meteorological conditions. Recent years have seen a revolution in a variety of computer vision applications thanks to deep learning techniques, especially CNNs, which automatically learn hierarchical representations from large-scale data. CNNs are excellent at identifying complex structures and patterns in images, which makes them a good choice for image restoration applications like single image dehazing. Single picture dehazing CNNs use deep learning to recover aesthetically beautiful and clear images from hazy inputs, improving their perceptual quality and usefulness for applications later on. In order to learn the underlying mapping between the two domains, a neural network is usually trained on pairs of hazy and correspondingly haze-free photos. This approach is known as single image dehazing using CNNs. The CNN learns to estimate atmospheric light and scene transmission—two essential elements for haze removal—through an iterative optimization process, producing dehazed photos with better visibility and clarity.

3.LITERATURE SURVEY

Schechner, Y.Y. et al [1] in 2001 This section presents a survey of several dehazing literatures. A concise overview of the literature is provided, summarizing the research and scholarly works of various authors.

Fan Guo, Bin, and Xie [2] in 2010 Techniques for removing haze are becoming more and more popular since it can be found in a variety of classifications. These techniques can be applied to create photographs that are clear, noise-free, and of excellent quality. picture restoration and picture segmentation are the two main categories into which the classifications are done. The particles in the atmosphere scatter this light in the air. The suggested work illustrates the picture generation process with a clean image. When it produces an image devoid of haze, the inverting method and the impact of polarization are both considered. Scene brightness and air light are the two elements that make up the image composition.

et al., G. Meng [3] in 2013, The paper's handling of inclement weather may detract from the visual appeal of its outdoor scenes. There is a deadline for many applications' dependability. Haze and fog are examples of atmospheric conditions that generate undesired situations by blurring the photographed view. There are always extra particles in the air that are dispersed, which causes

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the reflected light to become dispersed as well and reduces the visibility of faraway things. Attenuation and air light are the two fundamental phenomena that create the scattering. The term "restoration of images taken under bad atmospheric conditions" refers to a technology that has gained popularity in recent years.

Archana Kaushik, Alka Choudhary [4] in 2014 discuss the use of haze removal techniques in various applications, including underwater photography and satellite images. Haze removal is a challenging task due to the unknown depth information of fog, which requires estimation of air light lamps. The paper describes various methods for efficiently removing haze from remote sensing images and discusses filters used for dehazing. Haze removal is a widely demanded area in computer vision and computer graphics related systems, as the quality of outdoor scenes depends on haze, which is often degraded by light scattering. Haze removal algorithms are increasingly useful in computer vision applications, but the survey reveals that existing methods neglect noise reduction techniques, necessitating the development of more filtering methods.

Satbir Singh and Manpreet Kaur Saggu [5] in 2015 In the realm of image processing, image dehazing is essential. One of the main issues we found with image dehazing is that it is very difficult to identify white scenery items whose pixel values are intrinsically close to the values of atmospheric light. Recognizing the white scenery objects whose component prices are intrinsically similar to the prices of region lights is a crucial step in image dehazing. Therefore, a more reliable technique for image dehazing in a homogeneous atmosphere is needed. This study presented a straightforward, effective, and potent technique for image haze removal. It is a reliable technique that may reduce the impact of air haze and enhance the quality of hazy picture detection.

Sajana M Iqbal's [6] in 2015 general objective in this paper is to explore the short comings of previous techniques used in the revolutionary era of image processing applications. Factors such as object-camera motion, blur, and atmospheric violent features can cause degradations in images. The paper also discusses the impact of bad weather, such as fog and haze, on traditional systems. By effectively removing haze or fog, the stability and robustness of visual systems can be improved. The paper also highlights the need for a new integrated rule to address the issues of existing techniques and improve the overall performance of image processing applications.

Vinuchackravarthy and KrishnanKutty's [7] in 2015 study explores various haze removal techniques for computer vision and graphics applications. Haze, caused by attenuation and air light weight, diminishes scene visibility and color. The objective is to efficiently remove haze from digital images, which can obscure scenery objects due to smoke and dry particles. Experimental results show that the proposed approach achieves high and outstanding dehazing results, reducing the brightness of images in bad weather and enhancing the color of scenery.

Ms.S.Archana M.E, A.Abiraha [8] in 2016 This paper addresses the challenge of enhancing perceptual visibility in images degraded by atmospheric haze. Image degradation due to natural factors affects visual perception and interpretation, leading to loss of distinction, poor color rendering, and loss of depth data. Researchers have worked on removing atmospheric effects like haze, fog, and smoke to improve image understanding and feature detection. They propose an effective way of computing global atmospheric light and a new method for computing transmission maps using saturation and intensity values of hazy images. The modified haze removal model reliably restores perceptual visibility of hazy images, and an adaptive linear model with color attenuation prior information can recover depth information and restore outlook radiance. However, a common problem remains: the scattering coefficient β in the atmospheric scattering model cannot be considered a constant in homogeneous atmosphere conditions. A more flexible model is highly desired, and advanced physical models can be taken into account to overcome this challenge.

Revanasiddappa Phatate and Manjunath.V. [9] in 2016 The "change of detail algorithm" is a straightforward yet powerful prior for dehazing a single image. The input image gets fuzzy since this approach is based on the multiple scattering phenomenon. Combining this method with the hazy imaging model makes dehazing a single image simple and efficient. This technique may be used on a wide range of photos and is based on local content, which is rarer than color. Numerous physical models are considered in an attempt to address this limitation. Haze, fog, and mist are examples of suspended particles in the layer that induce dispersion, which frequently causes flyblown images during bad weather.

Shabna, Mr. C. S. ManikandaBabu [10] in 2016 Haze, a degradation of outdoor images due to light absorption and scattering by turbid mediums, can lead to degraded images in image processing. Automatic systems relying on input images may fail to work normally due to degraded images. Early research used traditional techniques like histogram-based dehazing, which was limited due to potential loss of infrequently distributed pixels and computational and storage requirements. Later, researchers improved dehazing impact with multiple pictures and depth.

4.EXISTING SYSTEM

Because CNN is adaptable, there may be an increase in computational complexity, particularly in situations requiring real-time processing. This might restrict its usefulness in settings with limited resources. For best results, CNN frequently needs to adjust its hyperparameters. It could be difficult to get reliable and consistent dehazing results across a range of datasets and environmental circumstances due to these factors' sensitivity. CNN's efficacy may differ depending on the scenario and the surrounding factors. It might not be able to generalize as effectively to uncommon atmospheric occurrences or extreme weather that isn't sufficiently represented in the training set.

Occasionally, artifacts may be unintentionally introduced by the adaptive convolutional filtering process, particularly in areas with high frequency details or close to object borders. This could cause visual distortions and have an impact on the dehazed image and video's overall quality. Gradient information is crucial to CNN's adaptive filtering. CNN performance may deteriorate in situations where gradients are ill-defined or uneven, for as in areas with homogeneous textures or poor contrast.

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5.PROPOSED SYSTEM

The suggested technique for dehazing images and videos not only advances image and video processing under difficult environmental circumstances. However, it also has potential for use in autonomous navigation, surveillance, and remote sensing, where precise analysis and decision-making depend on crisp, detailed images and videos. Using this image and video dehazing technique, the long-distance fog environment in the image and video will be eliminated.

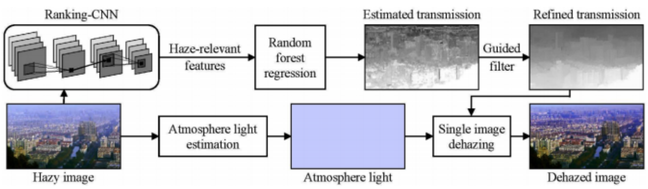

Fig 1 : Block diagram of Proposed model

6.IMPLEMENTATION

1. Programming Language and Frameworks:

Select a programming language that is appropriate for developing the dehazing method. Python is a good choice because it has a large library and deep learning framework. Make use of deep learning frameworks such as PyTorch, TensorFlow, or Keras, which offer high-level abstractions for effectively creating and training CNN models.

2. Data Preprocessing:

Normalize pixel intensities, resize photos to a uniform resolution, and supplement the dataset to boost diversity and robustness as preprocessing steps for the fuzzy input photographs. For training and assessment, create a dataset of hazy and correspondingly haze-free photos.

3. CNN Architecture:

Create a CNN architecture that takes into account the depth, width, and network complexity in order to dehaze a single image. To maximize performance, try out several CNN architectures, such as convolutional layer, pooling layer, skip connection, and normalization layer variants.

4. Model Training:

To train and evaluate the model, divide the dataset into test, validation, and training sets. With the use of suitable optimization techniques (like Adam, RMSprop) and loss functions (such mean squared error, perceptual loss), train the CNN model using the training set.Using tools such as TensorBoard, keep an eye on training progress, measure metrics like accuracy and loss, and display model performance.

5. Hyperparameter Tuning:

To maximize model performance, experiment with hyperparameter tuning by modifying network design, learning rate, batch size, and dropout rate, among other parameters.To effectively search the hyperparameter space, use methods like grid search, random search, or Bayesian optimization.

6. Model Evaluation:

Utilizing the validation set, evaluate the trained CNN model's performance in terms of perceptual fidelity, clarity, and image quality. To objectively measure the dehazing performance, compute evaluation measures including perceptual loss, structural similarity index, and peak signal-to-noise ratio (PSNR).

7. Inference and Deployment:

Use the trained CNN model to draw conclusions on fresh, fuzzy photos. It can be used independently or together with current image processing workflows. Use effective data loading techniques and inference algorithms to process photos either in batch mode or in real time, based on the needs of the application.

8. User Interface and Visualization:

Provide an intuitive user interface so that users may upload foggy photographs, communicate with the dehazing system, and view the outputs once they have been dehazed. Provide interactive widgets and visualization tools so that users may examine and contrast various dehazing techniques and parameter configurations.

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9. Testing and Quality Assurance:

To guarantee the dependability, stability, and robustness of the software implementation across various environments and input conditions, conduct thorough testing and quality assurance methods. To find and fix software problems, edge cases, and performance bottlenecks, run unit, integration, and system tests.

10. Documentation and Maintenance:

To make maintenance and collaboration easier in the future, make sure you document the software implementation, including the code structure, features, dependencies, and usage instructions. Set up procedures for code review, version control, and issue tracking to efficiently handle software upgrades, bug fixes, and feature additions.

7. RESULT

Fig 2: Hazy Image in Low Light condition

Fig 3: Dehazed Image Using CNN

8. CONCLUSION&FUTURE SCOPE

In conclusion, a major achievement in the fields of computer vision and image processing has been made with the creation and application of single picture dehazing utilizing convolutional neural networks (CNNs). Researchers and practitioners have made significant progress in reducing the negative impacts of air deterioration and haze on image quality and visual perception by employing deep learning techniques, especially CNNs. The literature review demonstrates the many techniques and methods used in CNN-based single picture dehazing, such as training plans, network designs, and assessment measures. A variety of CNN designs, optimization techniques, and loss functions have been investigated by researchers in an effort to boost dehazing performance and increase the perceived quality of dehazed images. Software implementation guidelines, which cover data preprocessing, model construction, and training, evaluation, deployment, offer a road map for creating reliable and effective dehazing systems. Developers may design scalable and user-friendly solutions for single picture dehazing by adhering to best practices in software engineering and deep learning. This will enable applications in several areas, including autonomous driving, remote sensing, photography, and surveillance. Future prospects for single picture dehazing research could include tackling issues including integrating multi-modal data sources, managing dynamic environmental conditions, and improving real-time performance and scalability. Moreover, interdisciplinary cooperation amongst atmospheric scientists, domain specialists, and computer vision researchers can support the creation of novel approaches to lessen the effects of haze and atmospheric deterioration on visual perception and picture interpretation. In summary, single picture dehazing with CNNs has enormous potential to advance applications in a variety of fields, improve visual understanding, and improve image quality. Sustained investigation and originality in this field will help create reliable, effective, and intuitive dehazing solutions that will have a significant impact on both society and technology. Provide adaptive dehazing algorithms with the ability to dynamically react to changing weather patterns, lighting conditions, and haze levels. To improve performance in dynamic outdoor conditions, tune dehazing parameters by incorporating real-time sensor data and environmental feedback systems. Investigate how to include multi-modal data sources, such as depth information, hyperspectral data, and infrared photography, to enhance the precision and resilience of single picture dehazing algorithms. Examine fusion methods to take advantage of

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complementing data from other sensor modalities, such as cross-modal embeddings, attention mechanisms, and multi-task learning. Contextual modeling methods and attention mechanisms should be incorporated into CNN architectures to help them focus on important areas of the image and use contextual information to remove haze more effectively. Provide interactive dehazing interfaces that let users experiment with different dehazing settings and explore different approaches and provide feedback to improve dehazing quality and user satisfaction.

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