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Haze Removal and Denoising using Globally Guided Filter and Bilateral Filtering

Pushpendra Pratap Singh
M. Tech Research Scholar
R.B.S Engineering Technical Campus Bichpuri
Agra, U.P., India

Dr. Pramod Sharma
Department of Electronics & Communication Engineering
R.B.S Engineering Technical Campus Bichpuri
Agra, U.P., India

Abstract--**In the presence of an atmosphere, light reflected from a scene is always dispersed before reaching the camera lens, and the light gathered by any camera lens is almost always mixed with the ambient light before reaching the camera lens. As a result, picture deterioration is unavoidable, with increased noise, decreased intensity contrast, and loss of color fidelity among the consequences. It is especially dangerous when the weather conditions are bad, like when aerosols such as haze, fog, rain, dust, or fumes are present in the air, as in a thunderstorm. When fog occurs naturally as a meteorological event, it may cause an albedo effect, which can result in ambiguity and noise. These occurrences, to a certain degree, have negative consequences for the perception and extraction of information from visual pictures. Therefore, effective haze removal (also known as dehazing) and denoising procedures are urgently required in real-world situations. For this purpose, a new method is proposed in this thesis. The method includes denoising using a bilateral filter and dehazing using globally-guided image filtering. The output shows significant improvement in the perceptual fog density parameter.**

Keywords- Dehazing, image, processing, noise removal, defog, perceptual fog density.

I. INTRODUCTION

In nearly any useful example, the light emitted from one object spreads in the atmosphere before arriving on the projector [1,2]. This is because aerosols such as soil, mist, and gases obstruct light's initial spread. In long-distance photography and foggy weather, the image with reduced highlights and poor ground colors has a noticeable influence [3]. These degraded pictures often lack graphical and appealing images, and the scene content is difficult to see [4]. This influence can be repulsive and reduce the appeal of underwater and aerial photography for amateur, commercial, and artistic photographers [5]. It may also be used for satellite imaging, such as geological and cloud-based mapping, as well as land planning and architectural architecture. As a consequence of the uniform illumination, there is a combined loss of picture contrast and an additive term. The design is used to formalize image formation in the presence of haze [6,7]. In this model, the degraded image is represented as a sum of two components: the input of air light and the unknown radiance of the earth [9-12]. The transmitting rate, a scalar that determines the illumination at each pixel, algebraically blends the two three-channel color vectors. To recover a hazel-free image, the three surface color values and the transition value for each pixel must be calculated [13-16]. the applicable criteria that follow.

Since the source image accounts for three formulas per pixel, the procedure is unpredictable and cannot determine transmission accuracy. Since a single image cannot answer the issue, consider looking over a dense white layer on a deep red surface and seeing a soft red surface on a neutral or transparent medium. In this analysis, a new method for recovering unaltered images obtained as input with a single photograph was created [17]. Haze reduces perceptibility and lowers the identifying feature of visible objects. Corruption for every pixel is distinctive and relies on the scene point distance from the lens. The transfer coefficients that regulate the scene constriction and calculate the cloudiness of each pixel reflect this dependency. Poor visibility in bad weather, including mist or fog, is a major challenge for many computer vision applications. Highly necessary for the quality of the graphical algorithm is the elimination of haze. The scope for this work holds importance in haze removal of an outdoor image for example hazy images taken from drones or for surveillance purposes and security. It has good scope in getting clear images in defense border areas and high-security areas.

The image is divided into areas of constant albedo, and the instability of air light-albedo is overcome by introducing an additional constraint that requires a regional statistical association of superficial shading and media transmission functions [18-20]. This paper gives new technology for denoising and dehazing.

II.IMPLEMENTATION

Using bilateral filtering in GGIF is expected to improve the accuracy of the noisy image. Dehazing of an image has important applications in drones for capturing images haze-free and noise-free and in various camera-based surveillance applications. It is important to define the best accurate perceptual fog density.
The block diagram for the methodology is shown in figure 1.

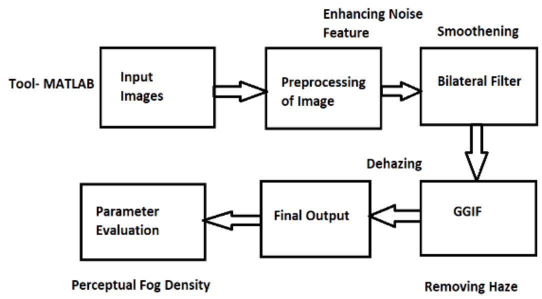

Figure 1: Block Diagram of Proposed Methodology

Several input images are taken into consideration for this thesis, which is shown in figure 2. this method is beneficial for indoor images with a high set of noise.

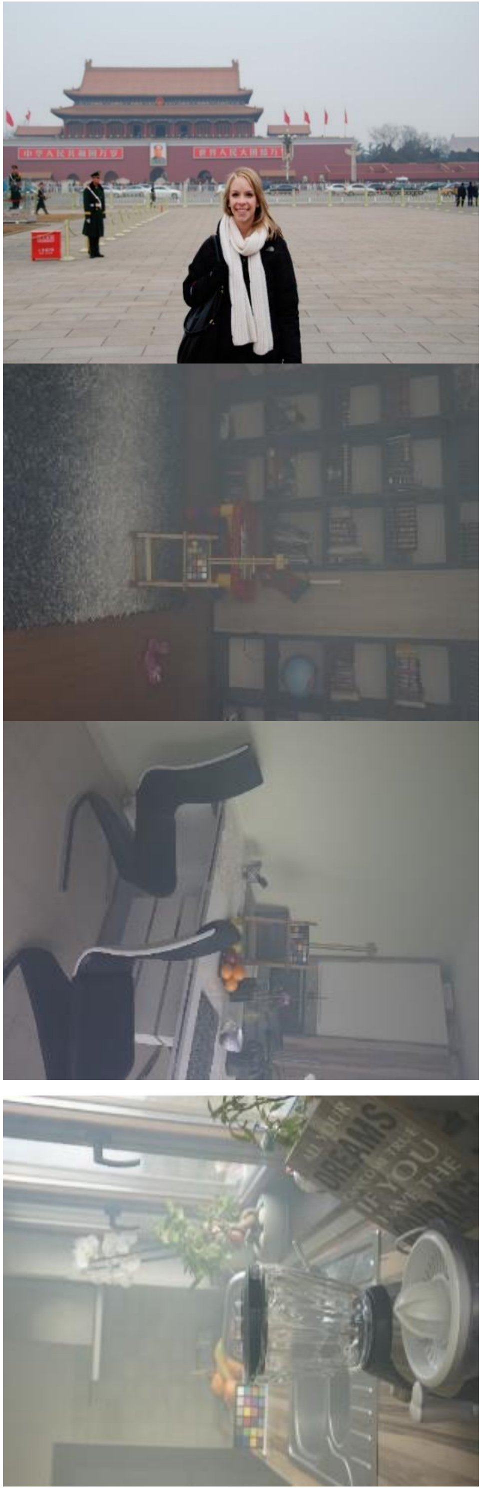

Fig. 2, Input Images for Implementation

In this section, the proposed algorithm is discussed theoretically for the image dehazing method. This new method consists of two phases: namely, globally guided image filtering (GGIF), and bilateral filter. A Globally Guided Image Filtering method is a mathematical equation-based filtering method that is applied with a global filter is used. In a bilateral filter, 2D filtering is performed in the input image.
Not at all like the GIF in [7] and the WGIF in [9], the proposed channel is a worldwide channel, and it is therefore called the G-GIF. Contributions of the proposed G-GIF are a picture to be sifted and a direction vector field while contributions of the GIF and WGIF are a picture to contrast data ought to be extraordinary be separated and a direction picture. The structure is characterized by the direction vector field. The proposed G-GIF is made out of a worldwide structure move channel and a worldwide edge-safeguarding smoothing channel. The capacity of the structure move channel is to move the predefined structure to the picture to be separated while the capacity of the smoothing channel is to smooth the moving picture in order to create the yield picture.
In GGIF, a box filter is created by taking values of sigma, mean, and variance using basic formulae, which is then applied to the GGIF edge-preserving algorithm. The factors into consideration of an image are covariance, mean, variance, and mean of variance known as alpha, which is then given to the following equation (1).

$$q = mean\_a * I + mean\_b; \qquad (1)$$

The method for haze removal i.e., GGIF globally guided image filtering is implemented and compared with the previous method. The tool used is MATLAB software.

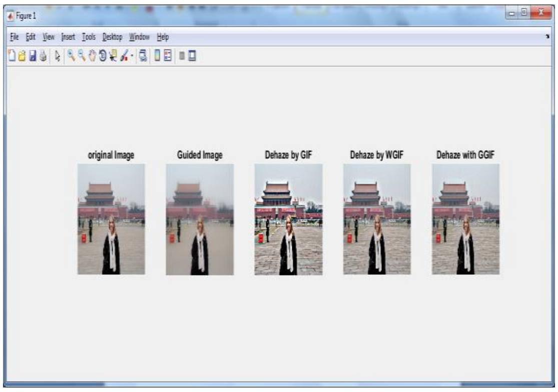

Fig 3. Comparison of the GIF, the WGIF, and the G-GIF

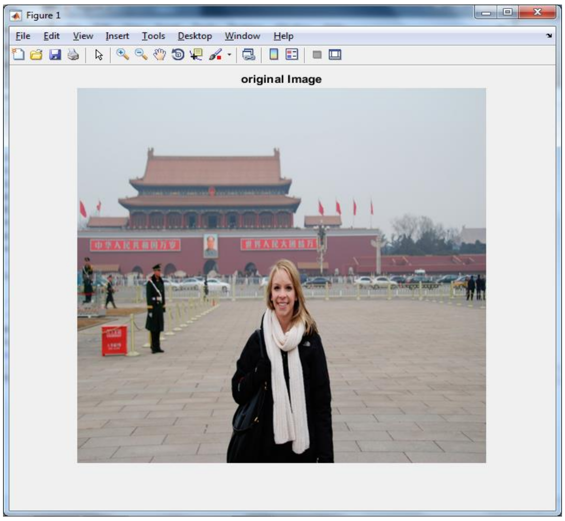

Fig. 4 Input

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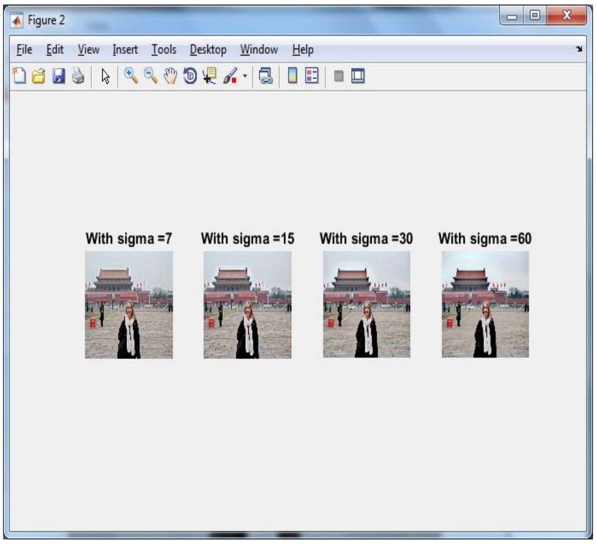

Fig. 5 ζ variation result

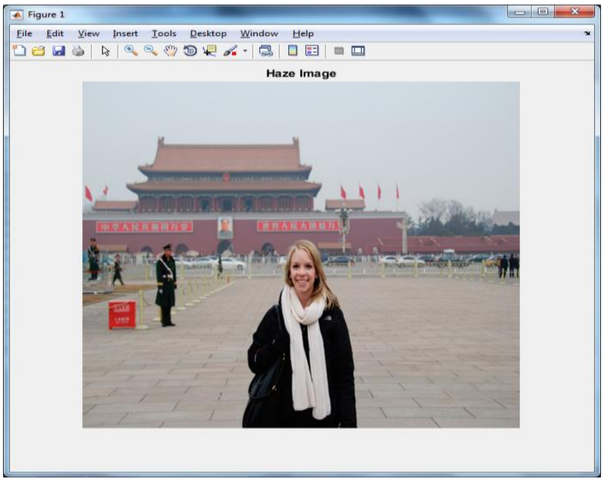

Fig. 6 a haze image input

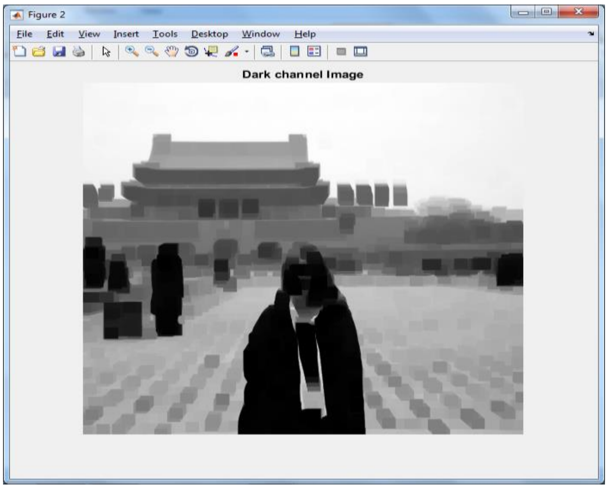

Fig. 7 simplified dark channel

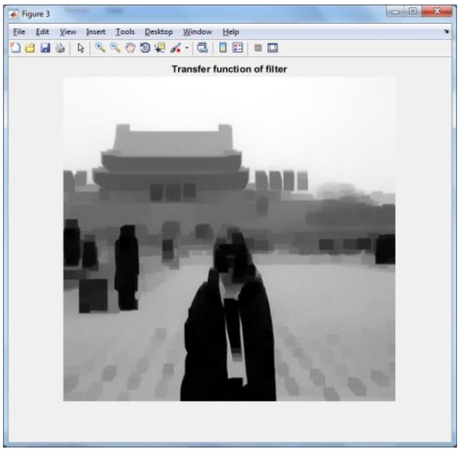

Fig. 8 output image of the structure transfer filter

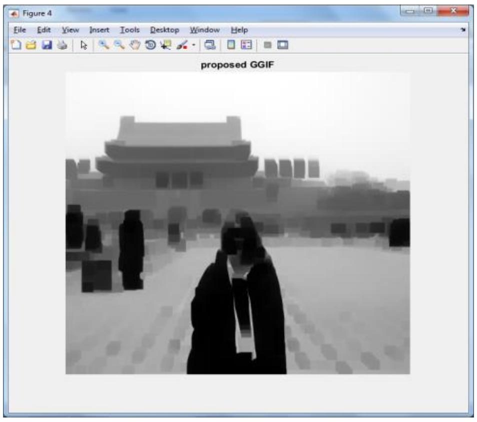

Fig. 9 output image of the G-GIF.

The bilateral filter is a non-linear algorithm that can obscure a picture while regarding solid edges. Its capacity to deteriorate a picture into various scales without causing haloes after the alteration has made it universal in computational photography applications, for example, tone planning, style move, relighting, and denoising. Bilateral filter smoothens the picture while protecting edges, by methods for a nonlinear blend of close-by picture esteems. It joins dim levels or tones in view of both their mathematical closeness and their photometric similitude and inclines toward close to qualities to inaccessible qualities in both area and reach. Interestingly with filters that work on the three groups of a shading picture independently, a bilateral filter can authorize the perceptual metric hidden in the CIE-Lab shading space and smooth tones and protect edges in a manner that is tuned to human insight. Likewise, interestingly with standard filtering, bilateral filtering produces no apparition colors along edges in shading pictures and lessens apparition colors where they show up in the first picture.

Figure 10 to figure 13 shows the implementation of the proposed work screenshots.

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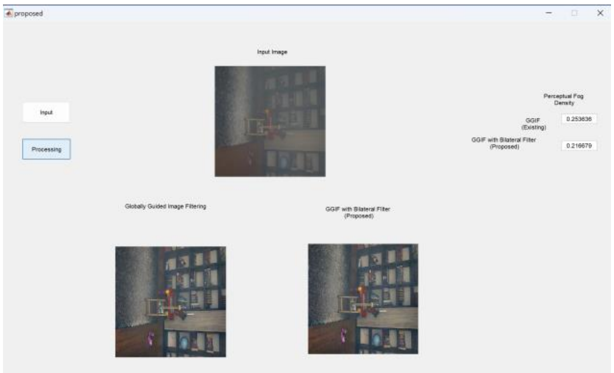

Fig. output screenshot for image 1

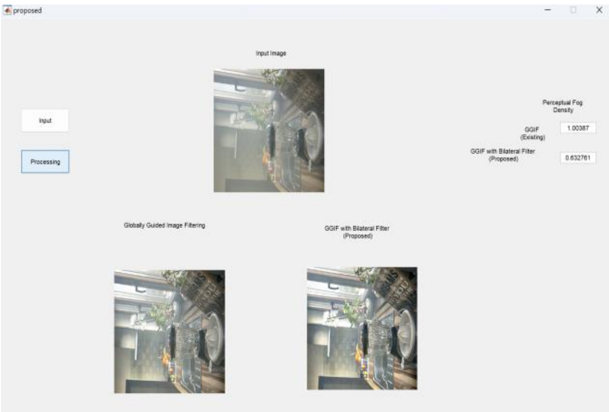

Fig. 11 output screenshot for image 2

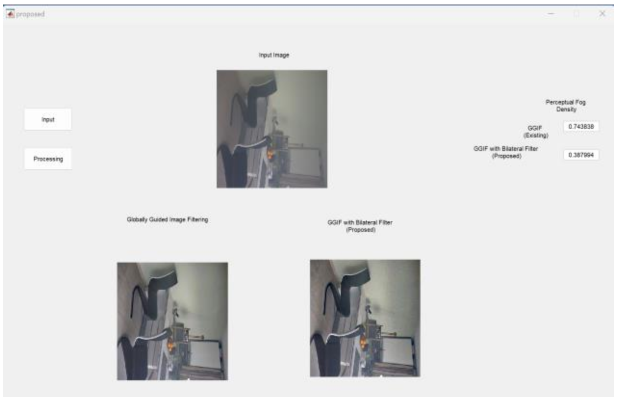

Fig. 12 output screenshot for image 3

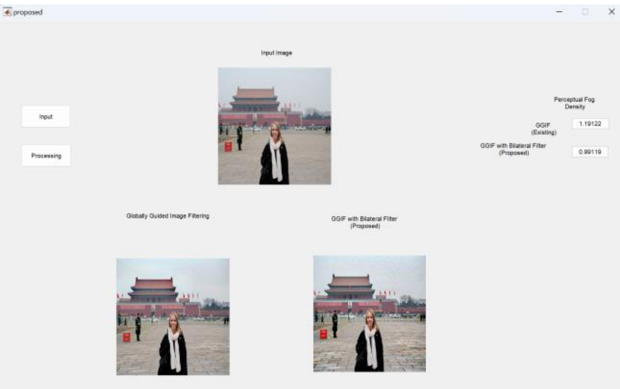

Fig. 13 output screenshot for image 4

III. RESULTS

The results for comparison between the existing and proposed work are shown in table 1.

Table 1: Comparison Results

	GGIF Existing	GGIF with Bilateral Filter
PFD input image 1	0.253636	0.216679
PFD input image 2	1.00387	0.632761
PFD input image 3	0.743838	0.387994
PFD input image 4	1.19122	0.9946

Figure 14 to figure 17 show the output comparison in charts and show that the proposed work works better in all cases.

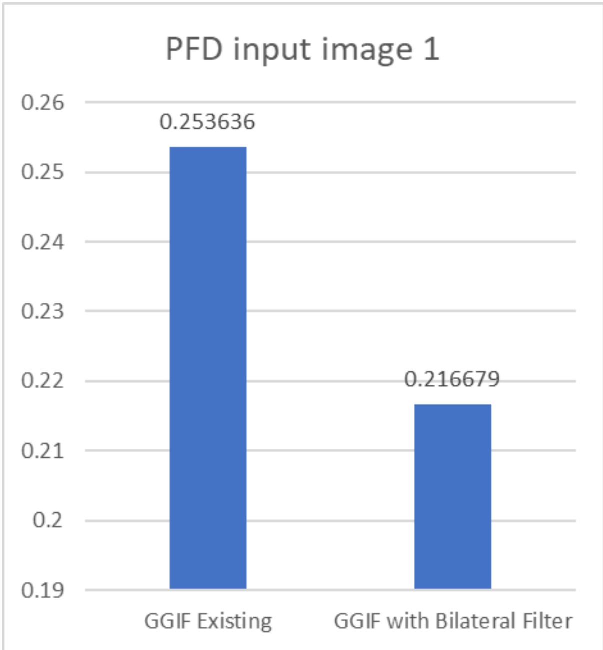

Fig. 14 PFD for input image 1

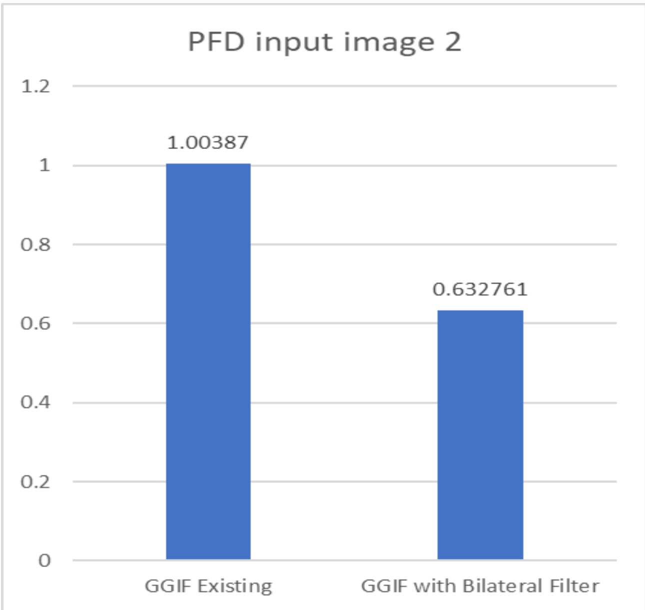

Fig. 15 PFD for input image 2

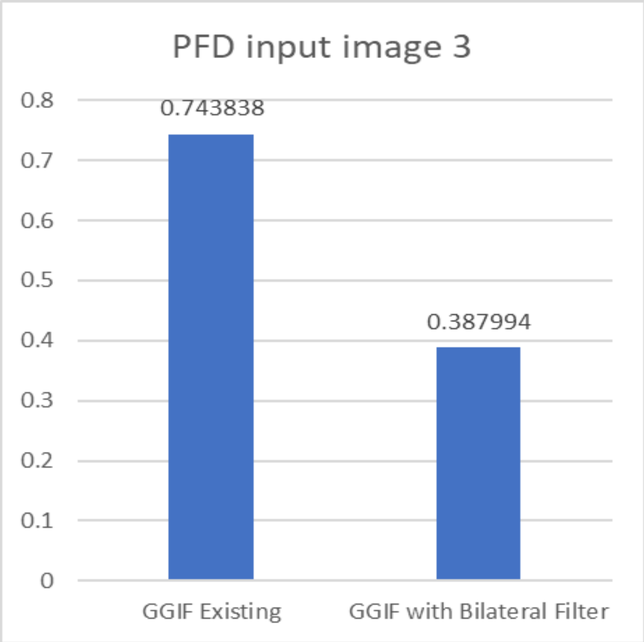

Fig. 16 PFD for input image 3

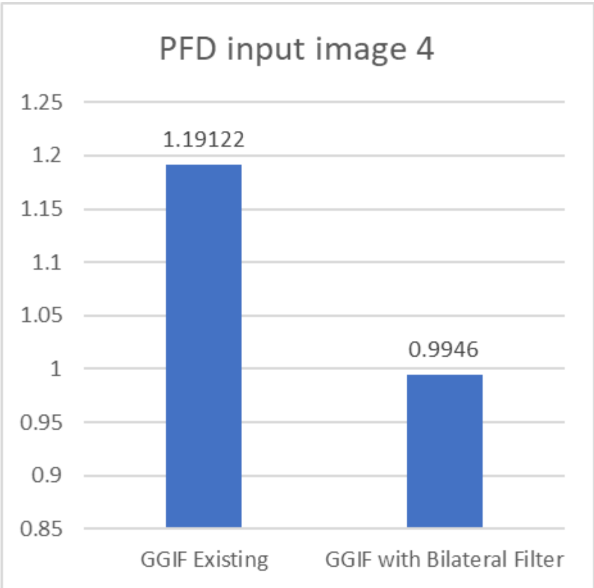

Fig. 17 PFD for input image 4

IV. CONCLUSION

Images of outdoor images taken in inclement weather are often marred by low visibility and poor contrast, and these degradations are not uniform throughout the picture. Image haze removal has emerged as a significant study path in the field of computer vision, owing to the rapid growth of the technology and the growing popularity of its applications. Outdoor photographs taken in poor weather have deteriorated because of elements such as noise and haze, which may obscure details. These elements have a significant impact on the visibility of the picture. It is possible for images to contain impulse noise, which is generated by the sensor and circuitry of image-capturing devices such as cameras. Additionally, images may include haze, which is created because of the interaction of two basic processes, namely, attenuation and refraction of light. Attenuation diminishes the contrast of the picture, whereas air-light enhances the whiteness of the image, resulting in images that are hazy and confused. In contrast to most prior dehazing techniques, which eliminate the haze effect in the spatial domain and are often plagued by the noise issue, this thesis proposes an efficient strategy to solving the picture dehazing and denoising problems, as well as the dehazing and denoising problems. In the proposed approach, the perceptual fog density yields a better outcome than before.

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