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Deep Learning and Globally Guided Image Filtering Technique based Image Dehazing and Enhancement

Anjali Pareek[1], Dr. Renu Bagoria[2]
[1]Computer Science Engineering, Jagannath University, Jaipur, India
[2]Professor, Computer Science Engineering, Jagannath University, Jaipur, India

Abstract: Haze in images is due to natural environmental phenomena, which makes the image in a white shade noise. Haze removal is one of the most important research topics these days to due popularity of applications in real time surveillance from drones or any area under security. Both indoor and outdoor images are important for testing haze and its removal. Many image processing techniques are made by researchers to remove haze in a single image. Haze intensity can be calculated by a parameter known as perceptual fog density (PFD). It is important to analyze this parameter for all the techniques so as to get an idea of improvement. In this paper , a new approach is made by applying globally guided filtering technique with deep neural network. This proposed algorithm is implemented on MATLAB software and results are obtained by calculating the PFD in the existing and proposed technique. The four techniques are compared with each other. The techniques are global filtering (GIF), weighted global filtering(WGIF), Globally guided filtering(GGIF) and proposed technique i.e. Globally guided filtering with DNN (Deep Neural Network). In GIF, the fine structure of the image is generally not preserved and unrealistic image is obtained. In WGIF, the PFD obtained is highest. In GGIF, PFD is lower and Structure is not preserved, but in proposed algorithm, the PDF is minimum with fine structure, color intensity of the picture is of the best quality.
Keywords: GGOF, Deep Learning, Dehazing, image, processing

I. INTRODUCTION

The light reflected from one object stretches in the atmosphere before landing on the screen in almost every useful scenario. [1] This is because there are aerosols like dirt, mist and gases that block light from its initial spread. The picture in which the highlights are diminished and the ground colors become weak in long-distance photographic and foggy conditions has a significant effect. [2] These deteriorated photos frequently lack graphical and attractive images, and in addition, the scene material provides poor visibility. This effect can be of disgust and can weaken the value of under-water and aerial photography for amateur, industrial and creative photographers. [3] It may also be used for satellite imagery, including geological and cloud-based mapping, land planning and architectural design. The result is a cumulative loss of picture contrast and an additive term because of this uniform light. The template used in the presence of haze to formalize image creation. [4] The degraded picture is interpreted in this model as a total of two components: the contribution of air light and the uncertain radiance of the ground. The transmission rate, a scalar that sets the visibility at each pixel, combines the two three-channel color vectors algebraically. [5] The 3 surface color values and the transfer value for each pixel must be determined in order to recover a hazel-free image. [6]

The process is uncertain and cannot evaluate the transmitting quality because the source picture accounts for three formulas a pixel. [7] Because the question cannot respond on the basis of one single image is: look over a thick white layer on a deep red surface and see a soft red surface on a similar or translucent medium. [8] A new way to recover an unspool images received as an input with a single photograph in this study. The picture is split into the areas of a constant albedo, and the uncertainty of air light-albedo is solved by creating an additional restriction that needs a regional statistical correlation of superficial shading and media transmitting functions. [9] This requires a significant difference between the shading element and the noise in the picture. The uncorrelation theory is also used to measure the hue of the air sun. This approach is passive: numerous scene frames, light blocking distortion, data regarding landscape distance, or advanced sensors or equipment are no longer necessary. [10] It also does not suppose that the hazel surfaces are smooth in place, i.e. scene depth and medium thickness discontinuities are needed. The new method includes one photo taken by a normal brand lens.

Fig. 1: Dehazing techniques GIF, WGIF and GGIF [1]

This new method, as shown at Fig. 1, is able to reduce air light dramatically and restore contrast in the complex scenes, despite the challenges presented by this issue. This algorithm is regarded as a filtering technique globally directed. Nevertheless, this approach transforms the strength of the object into good considerations. Photo dehazing is an extensive testing method that includes meteorology, practical mechanics and Computer sight and PC diagrams. The cloudiness accompanying the fog and skeletons are elements that narrow the air optical spectrum and significantly reduce the dividing line in visual scenes, for instance. Nebulous objects are more visually appealing. Second, most of the estimates of image production, from the lowest to the highest-level acknowledgement, usually expect the photo as the elegance of the scenario. The operation of the PC sight measurements (e.g.) would essentially undergo a subjective, low-differentiation scene elegance. In terrible situations, the need for image shredding is mostly illustrated when managing electronic artifacts. Image Dehazing is an awkward issue, since it relies on obscure information and data is a single image.

II. IMPLEMENTATION

.In this section, proposed algorithm is discussed thesoritically for image dehazing method. This new method consists of two phases: namely, globally guided image filtering(GGIF) and Deep Learning or Deep Neural Network(DNN). Globally Guided Image Filtering method is a mathematical equation based filtering method which is applied with global filter and a WLS filter is used. In DNN, a haze free images are already trained in the data base, then according to matching similarity the haze free images are tested according to intensity variable values.

A. Globally Guided filtering GGIF

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 moved 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 formaulae, which is then applied to GGIF edge preserving algorithm. The factors into consideration of an image are covariance, mean, varianace, mean of variance known as alpha, which are then given to the following equation 4.1.

q = mean_a * I + mean_b; eqn 4.1

the output q is then feb to WLS filter for further processing of GGIF technique. The final GGIF output is then passed through the Deep Neural Network.

In WLS filter the alpha, mean and variance are passes through a set of equations which are basically a mathematical laplacian functions. A straightforward dimness picture model is determined by utilizing the disentangled dim channels of the standardized murkiness picture. From a factual perspective, if the two examples are close or comparative, i.e., the separation between them is little or the closeness is high, they give little data; despite what might be expected, the distinction data ought to be extraordinary.

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B. Deep Learning Networks

DNN, a trainable start to finish framework that unequivocally learns the mapping relations between crude foggy pictures and their related medium transmission maps. In this segment, present layer plans of DNN, and talk about how these plans are identified with thoughts in existing picture dehazing strategies. The proposed DNN comprises of fell convolutional and a pooling combination layers, with proper nonlinear actuation capacities utilized after a portion of these layers. In this, firstly the white balance image is created, dehazing parameters trained are loaded, passed through nnconv and nnpool layers. the features are extracted through multi mapping local extremum calculations. The nnloss layer is applied, after which softmax layer is applied, proceeding with relu layer and offset layer for neural networks in image dehazing context. Then normalizing of layers are taken into considerations. The final layer output inage is saved for checking the perceptual fog density.

C. Proposed Algorithm

The complete algorithm combining the two phases of the proposed implementation is shown below:

1) *Step 1:* A GUI is creating using GUIDE in MATLAB, define pushbuttons for processing and input image.
2) *Step 2:* input image user interface to select the hazy image. Click on processing.
3) *Step 3:* Initially GIF, WGIF, GGIF, will run, these are exisiting algorithm part and their PFD will be calculated.
4) *Step 4:* Apply GGIF again on input image, the output of which is passed through WLS filter.
5) *Step 5:* Apply DNN by adjusting the gamma intensity parameter.
6) *Step 6:* Apply COnv, pool, Softmax, Relu and offset layer on features extracted.
7) *Step 7:* Test the final image on PFD.
8) *Step 8:* View edge preserving and fine structure and color map accuracies.
9) *Step 9:* Repeat for all images.

D. Flowchart of Proposed Algorithm

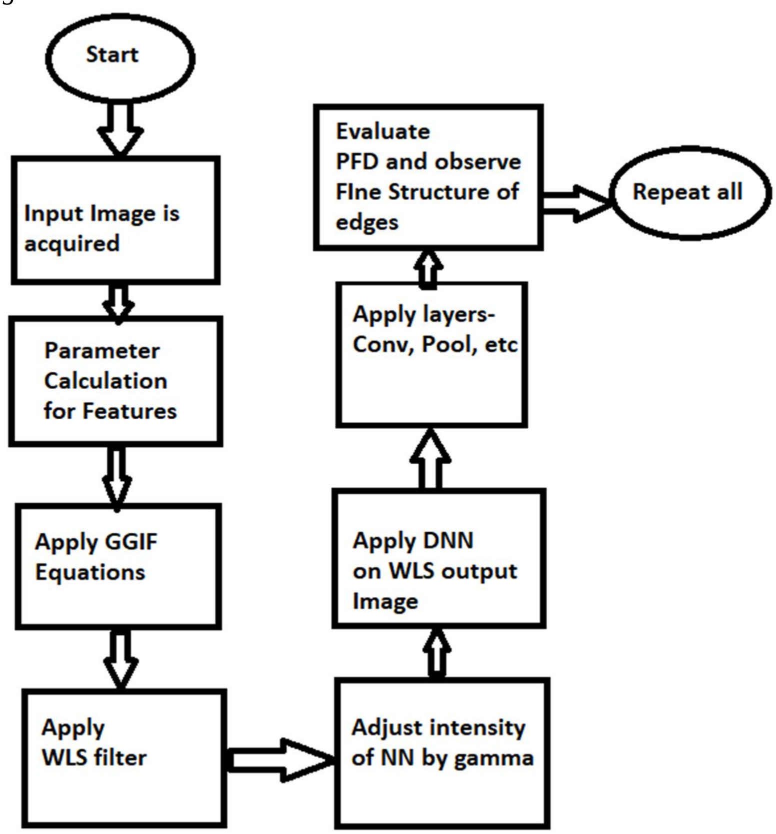

Fig. 2: Flowchart of Proposed Algorithm

In fig. 2, the flowchart of proposed algorithm is presented. Now results of all input images will be seen in the following section.

III. RESULTS

In this section, the results of all images are seen on the basis of PFD and its edge preserving and fine structure of the colors are observed.

In fig. 3, the GUI of first image is shown, and on right side it shows the PFD calculation of different images.

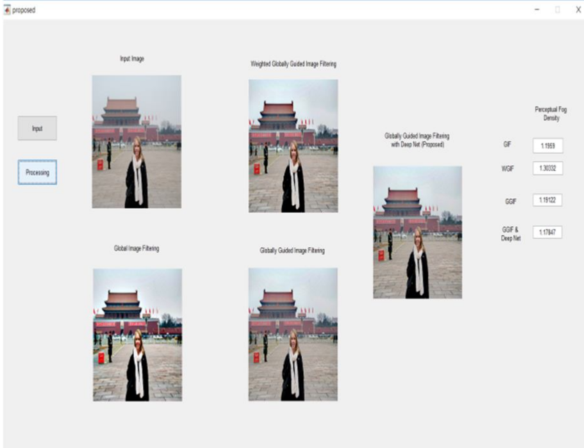

Fig. 3: Input Image 1 Output

In fig. 3, the fine structure is good in proposed and the PFD is lowest as seen in fig. 4.

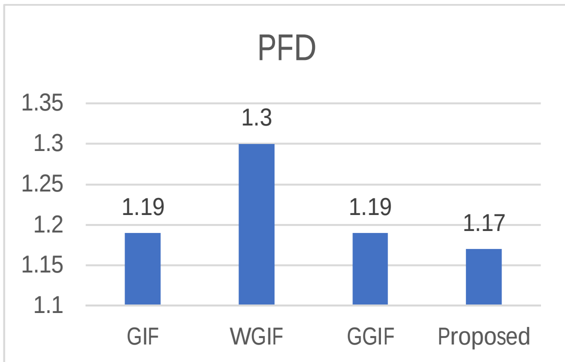

Fig. 4: Input Image 1 PFD Output

In fig. 5, the fine structure is good in proposed and the PFD is lower in case of proposed algorithm but similar to GIF and GIF does not have good color Structure as seen in fig. 6.

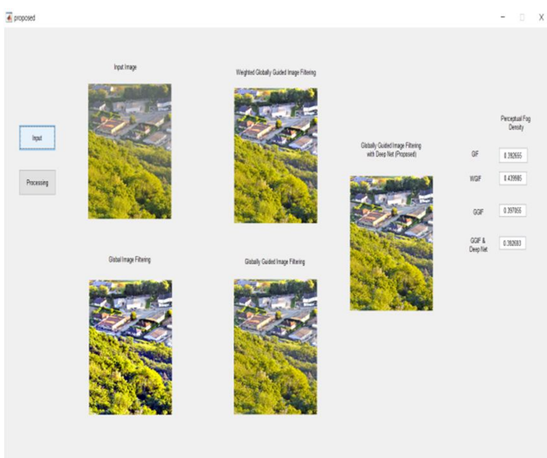

Fig. 5: Input Image 2 Output

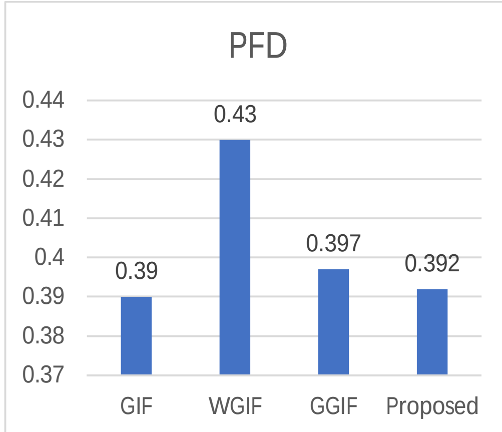

Fig. 6: Input Image 2 PFD Output

In fig. 7, the fine structure is good in proposed and the PFD is lowest, but GIF is lower and color structure does not look realistic as per image and output as seen in fig. 8.

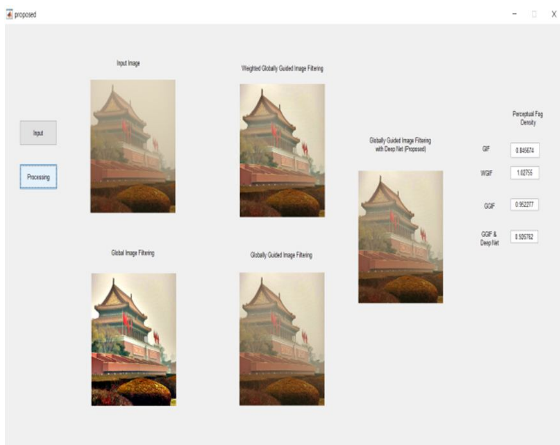

Fig. 7: Input Image 3 Output

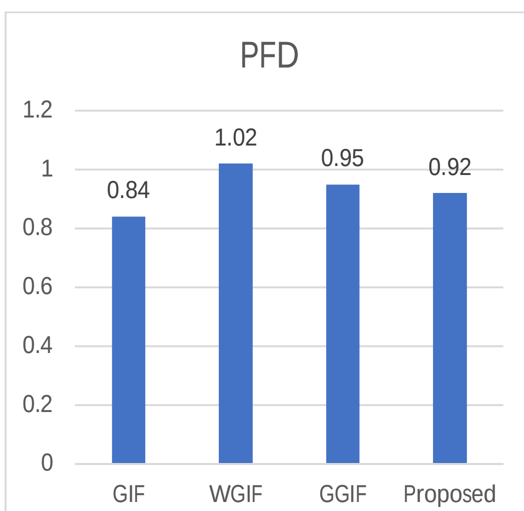

Fig. 8: Input Image 3 PFD Output

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In fig. 9, the image is good haze free in proposed and the PFD is lowest as seen in fig. 10.

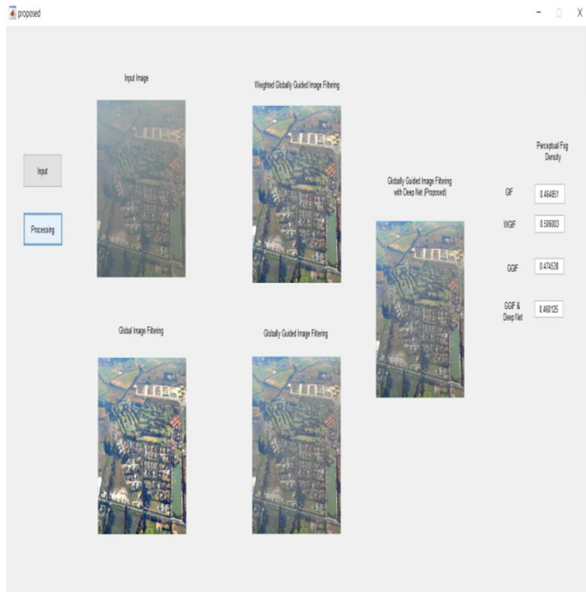

Fig. 9: Input Image 4 Output

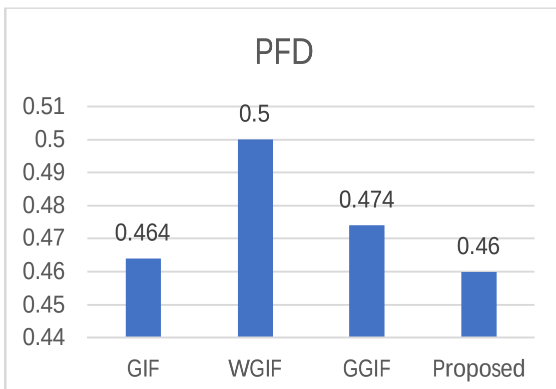

Fig. 10: Input Image 4 PFD Output

In fig. 11, the image is enhanced in proposed algorithm and the PFD is lowest as seen in fig. 12.

Fig. 11: Input Image 5 Output

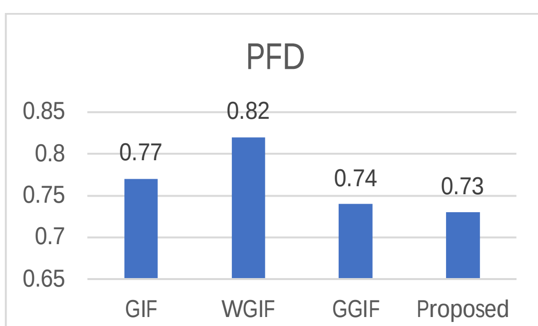

Fig. 12: Input Image 5 PFD Output

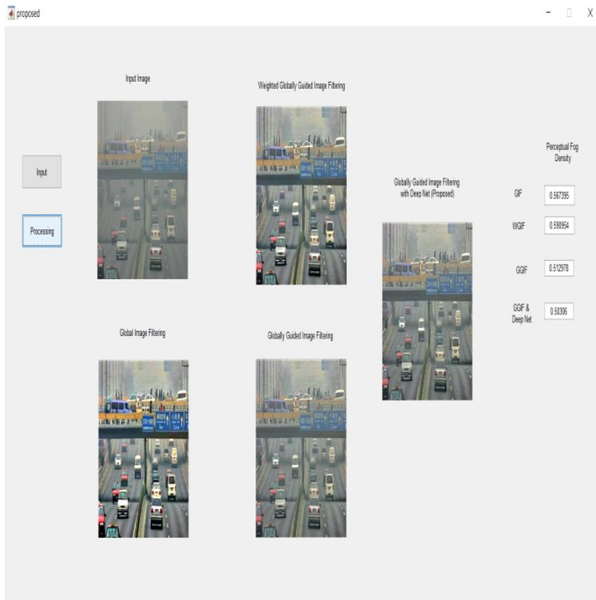

Fig. 13: Input Image 6 Output

In fig. 13, the traffic image is best enhanced in proposed with proper edges and colors and the PFD is lowest as seen in fig. 14.

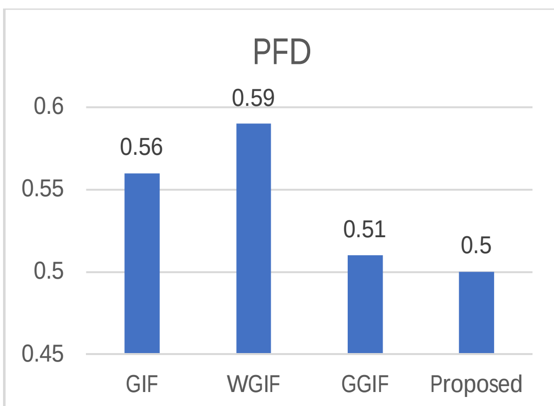

Fig. 14: Input Image 6 PFD Output

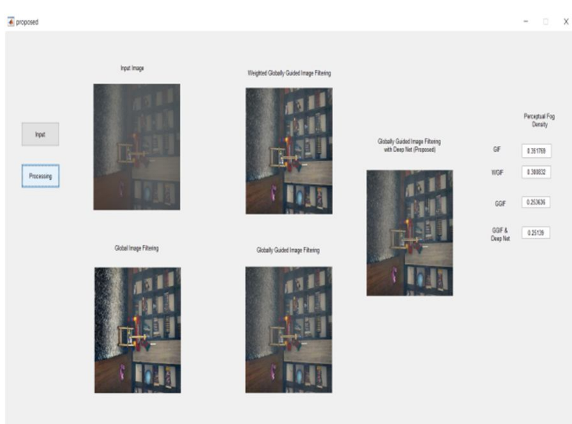

Fig. 15: Input Image 7 Output

In fig. 15, the indoor image is enhanced and haze free in proposed algorithm and the PFD is lowest as seen in fig. 16.

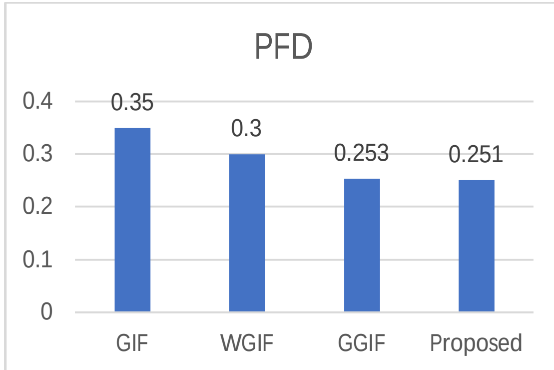

Fig. 16: Input Image 7 PFD Output

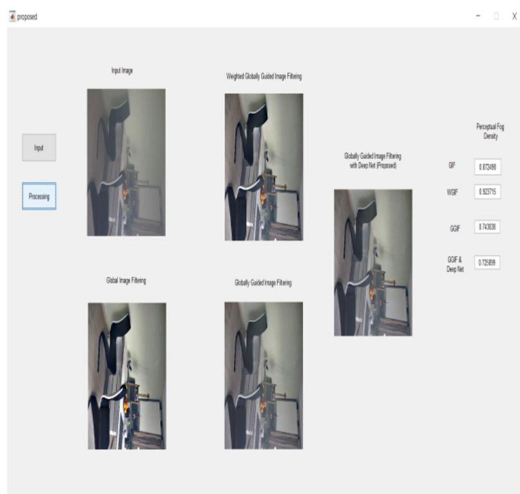

Fig. 17: Input Image 8 Output

In fig. 17, the image for indoor office is good in proposed and the PFD is lowest as seen in fig. 18.

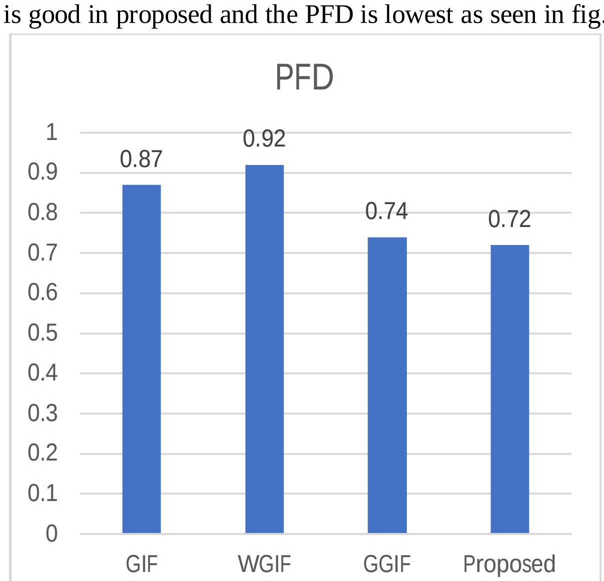

Fig. 18: Input Image 8 PFD Output

In all the images, the benefit of the proposed technique is seen and verified by output results.

IV. CONCLUSION

Pictures caught in dim or foggy climate conditions can be truly corrupted by dissipating of barometrical particles, which diminishes the difference, changes the shading, and makes the object highlights hard to distinguish by human vision and by a few open-air PC vision frameworks. Along these lines picture dehazing is a significant issue and has been generally looked into in the field of PC vision. In this paper , the hazy images are improved by removal of haze, edge preserving, fine structure checking, and realistic colr matching is done to improve the image characteristics using deep learning neural network and an existing technique known as the globally guided image filtering technique. Machine learning is important part of image processing and several techniques are msde to improve the hazy images. The main parameter of consideration is perceptual fog density which is improved in the proposed algorithm. This software is made on MATLAB environment, and its able to run any number of images with any size and features and can be made haze free with utmost accuracy and color structures are preserved.

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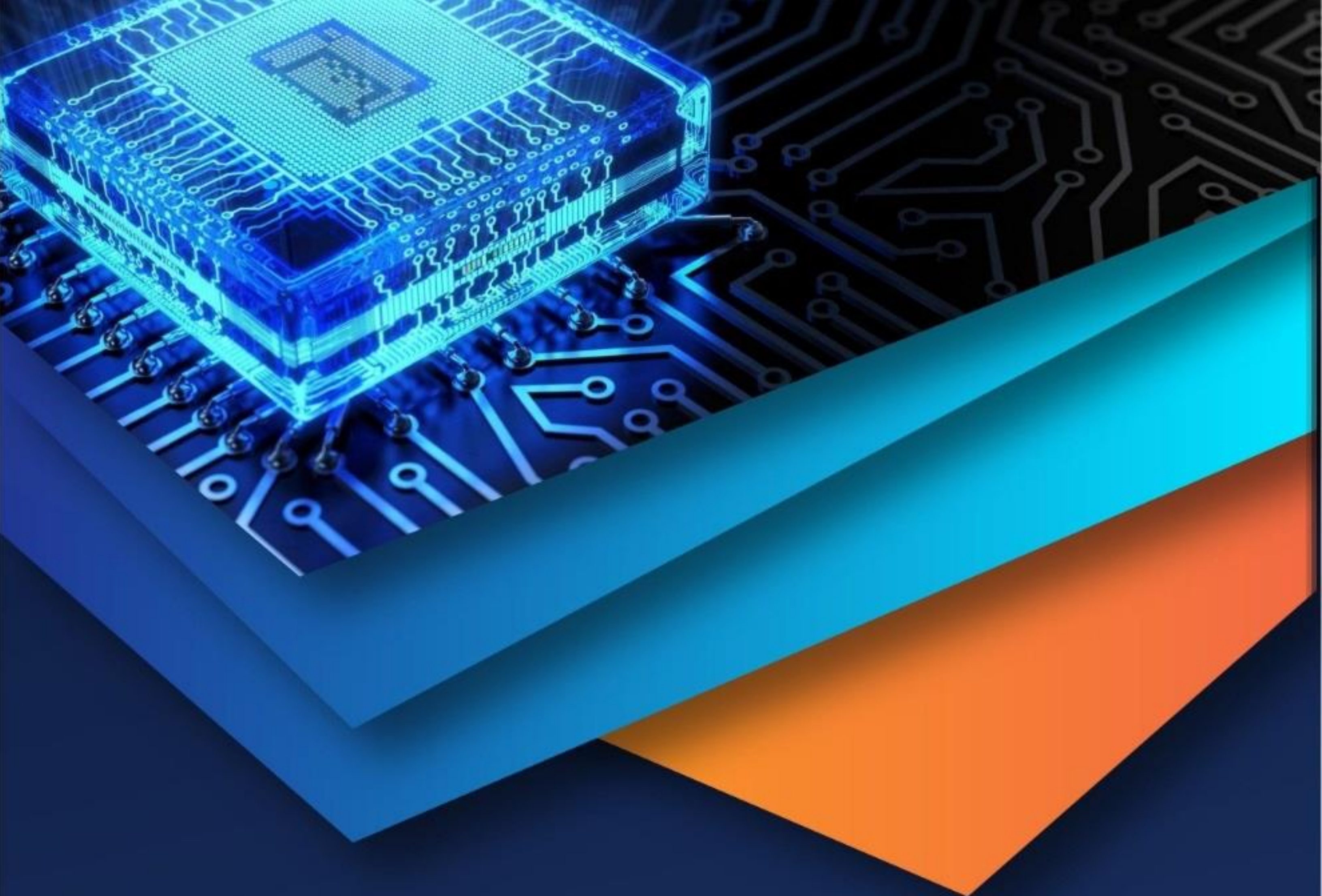

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