International Journal of Advanced Development in Science and Technology
IJADST Volume : 3 Issue : 03 April 2021 www.ijadst.com e-ISSN: 2582-1059

# IMAGE DEHAZING BY LAPLACIAN OPERATOR WITH CONTRAST ADJUSTMENT

[1] Anantha Lakshmi G, [2] Pooja J, [3] Reena R, [4] Kapilavani R K,

[1,2,] Student, [3] Supervisor, [4] Coordinator, Department of Computer Science

Prince Shri Venkateshwara Padmavathy Engineering College, Ponmar, Chennai.

lakshmi.ganesan2000@gmail.com.

## ABSTRACT:

*Single image super-resolution (SISR) is an extremely hot topic in the field of computer vision, which aims to reconstruct a super-resolution (SR) image from a single low resolution (LR) one. The soft edge has been widely applied in many computer visiontasks as the role of an important image feature. A soft edge reconstruction networkis the CNN model used to reconstruct theimage soft-edge directly from the LR image. The Edge Net can work independently for the image soft-edge reconstruction, or be embedded as a subnet into any SR model to provide image soft-edge prior for high-quality SR image reconstruction. In the proposed system we used to improve the visibility of underwater images using dehazing algorithm. The method of image contrast enhancement on the basis of the contrast distribution at the boundaries of objects and background on the image is proposed. Further the botanical name of aquatic plant is also determined using DNN.*

**Keywords: CNN, dehazing algorithm, DNN**

## INTRODUCTION:

Super resolution is the process of recovering a High Resolution (HR) image from a given Low Resolution (LR) image. An image may have a "lower resolution" due to a smaller spatial resolution (i.e. size) or due to a result of degradation (such as blurring). We can relate the HR and LR images through the following equation: **LR = degradation (HR).**

Due to absorption and scattering by atmospheric particles in haze, outdoor images have poor visibility under inclement weather. Poor visibility negatively impacts not only consumer photography but also computer vision applications for outdoor environments, such as object detection and video surveillance. Haze removal, which is referred to as dehazing, is considered an important process because haze-free images are visually pleasing and can significantly improve the performance of computer vision tasks.

Cameras are very popular sensors in underwater applications. They are relatively cheap, provide data with high update rate and may be used for tasks ranging from general exploration to object recognition and manipulation. On the other hand underwater imaging suffers from exceptionally bad light conditions and significant refraction based distortions. Image deformations may be corrected with calibration, using for example the recent Pinax model. But the problems related to underwater light propagation are much more complex as light is strongly attenuated and scattered.

**RELATED WORK:**

Similarly, in [14, 15], multiple images of the same scene are captured under different weather conditions to be used as reference images with clear weather conditions. However, these methods with multiple reference images have limitation in online image dehazing applications [14, 15] and may need a special imaging sensor [6, 9, 17]. This leads the researchers to focus the dehazing method with a single reference image. Single image based methods rely on the typical characteristics of haze-free images. Tan [13] proposed a method that takes into account the characteristic that a haze-free image has a higher contrast than a hazy image. By maximizing the local contrast of the input hazy image, it enhances the visibility but introduces blocking artifacts around depth discontinuities. Fattal [12] proposed a method that infers the medium transmission by estimating the albedo of the scene. The underlying assumption is that the transmission and surface shading are locally uncorrected, which does not hold under a dense haze.

Many methods can be implemented for underwater image enhancement and restoration. However, it is found that the traditional method of generalized unsharp masking, probability-based method and histogram equalization cannot effectively adapt the degradation of underwater images [3]. The studies of [8] and [11] have proposed a method of the dark channel prior (DCP) in which this approach is physically able to handle heavily hazy images.

**METHODOLOGY:**

**Pre-processing**:

Pre-processing techniques used are briefly discussed in this section. In image processing, pre-processing is the most vital step that must be taken to make sure that the image information content and quality are prepared for further processing [11]. As this project is dealing with the underwater plants, thus a camera will be placed under water. In underwater image processing study, image enhancement and image restorations are very important because the medium of water itself causes the light absorption and scattering which make the visibility of underwater is only within 20 meters [12]. The underwater hazy image

IJADST

International Journal of Advanced Development in Science and Technology

Volume : 3 Issue : 03 April 2021 www.ijadst.com e-ISSN: 2582-1059

formation model that is contributed by Koschmieder can be simplified as [13]:

I (x)  J (x)*t (x)  (1t (x))*B , [red, green,blue]

(1) where Iλ (x) is input image captured by the camera, Jλ (x) is radiance scene at point x, tλ (x) is reflecting residual energy ratio J(x) from point x, Bλ is homogenous background light and λ light wavelength of the red, green and blue spectrum.

**Normalization:**

Image normalization is a typical process in image processing that changes the range of pixel intensity values. Its normal purpose is to convert an input image into a range of pixel values that are more familiar or normal to the senses, hence the term normalization. In this work, we will perform a function that produces a normalization of an input image (grayscale or RGB). Then, we understand a representation of the range of values of the scale of the image represented between 0 and 255, in this way we get, for example, that very dark images become clearer. The linear normalization of a digital image is performed according to the formula

Output_channel = 255 * (Input_channel - min) / (max-min)

If we are using a grayscale image, we only need to normalize using one channel. However, if we are normalizing a RGB (3 channels) we need to normalize for each channel using the same criteria.

**Fig. 1 The left image depicts the original image while the right picture shows the results after the normalization process. We can see that the original image is too dark while the normalized is not.**

**Fig. 2 The left image depicts the original image while the right picture shows the results after the normalization process. We can see that the original image is very bright and difficult to observe by the human eye, while the resulting image presents a better contrast.**

The median filter (Laplacian operator) is used in order to remove the noise from the image. Still there may be some presence of negative frequency components. It is made to perform action on low frequency information.

International Journal of Advanced Development in Science and Technology
IJADST Volume : 3 Issue : 03 April 2021 www.ijadst.com e-ISSN: 2582-1059

**DCP-based image dehazing:**

In the DCP-based dehazing algorithm [10], the dark channel is first constructed from the input image as in Eq. (4). The atmospheric light and the transmission map are then obtained from the dark channel. The transmission map is further refined, and the haze-free image is finally reconstructed as Eq. (3).More specifically, given the degradation model of

$$I(x) = J(x)t(x)+A(1-t(x)),$$

The minimum intensity in the local patch of each color channel is taken after dividing both sides of the Equation. The transmission in the local patch Ω(x) is assumed to be constant. The atmospheric light needs to be estimated in order to obtain the transmission map.

**Dark channel construction:**

Most conventional DCP-based dehazing methods estimate the dark channel from the input hazy image I. In Eq. (4), the size of the local patch Ω(x) is the only parameter that needs to be determined. Although the effect of the size of the local patch is significant, most conventional methods simply use a local patch with a fixed size or do not specify the size of the local patch.

A dark channel is created and a patch size of 9 is made.The region near zeros is to be highlighted for the enhancement and brightness preservation. Hence, after the application of this transform, the region around zeros is enhanced.

**Histogram Equalization:**

You can adjust the intensity values of image pixels automatically using histogram equalization. Histogram equalization involves transforming the intensity values so that the histogram of the output image approximately matches a specified histogram.The original image has low contrast, with most pixel values in the middle of the intensity range. histeq produces an output image with pixel values evenly distributed throughout the range.

This is followed by grouping of pixels, where clustering is done to increase the high resolution pixels. At this stage, the image pixels are converted back to RGB color model and pixels highlighted to a certain level.Finally the botanical name of the plant is classified using DNN with the Database created. The database consists of 100 trained images and a neural network with 4 hidden layers.

This model is trained using 6 epochs (passes through the 100 items). The loss (also known as training error) slowly decreases and the prediction accuracy slowly increases, indicating training is working.The system architecture is given below in Fig. 3.

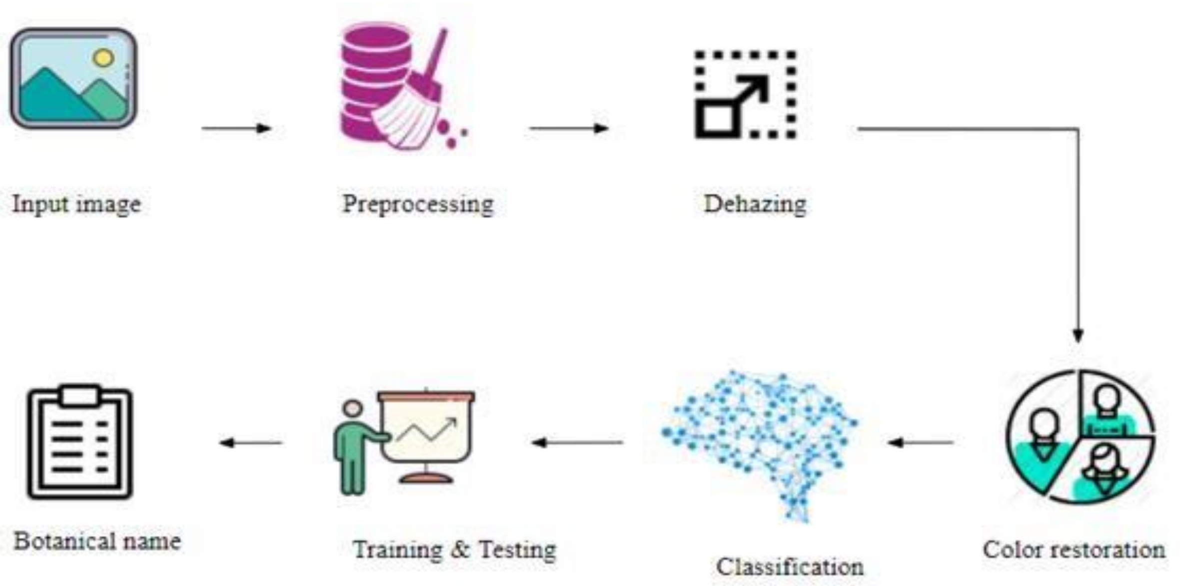



Fig. 3 System Architecture

**RESULTS AND DISCUSSION:**

The image with haze is uploaded by the user. After uploading the image, pre-processing is done such as resizing, background subtraction and contrast adjustment. All input images are resized to a common size of pixel size (300,300).

The area around the plant is identified and subtracted from the original image. It increases the color intensity so that it is somewhat identifiable. It adjusts the intensity so that we can give it as an input to the dehazing algorithm(which requires images of moderate intensity).

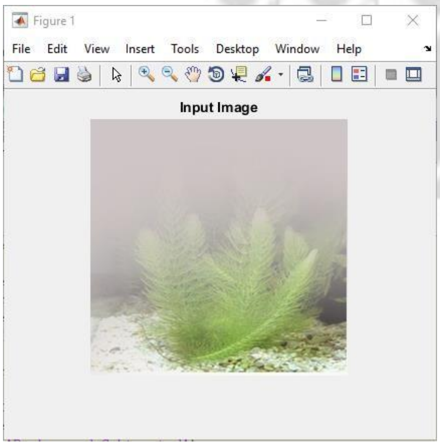



**Fig. 4**

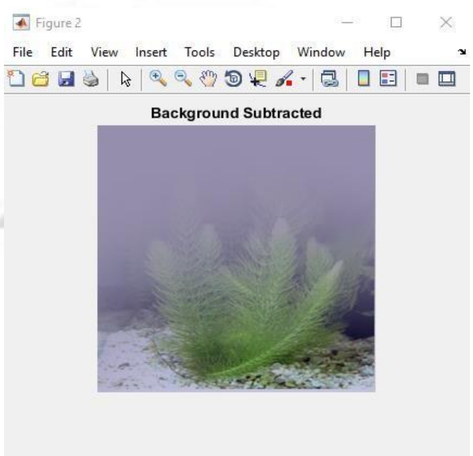



**Fig. 5**

International Journal of Advanced Development in Science and Technology
IJADST Volume : 3 Issue : 03 April 2021 www.ijadst.com e-ISSN: 2582-1059

Here the contrast of the overall image is adjusted to a range between 0.4 to 0.9.

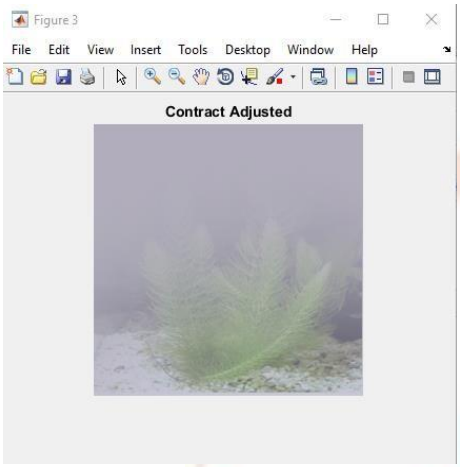



**Fig. 6**

The image is converted in the form of patches (dark channel prior) to recover the actual coverage area of the aquatic plant.

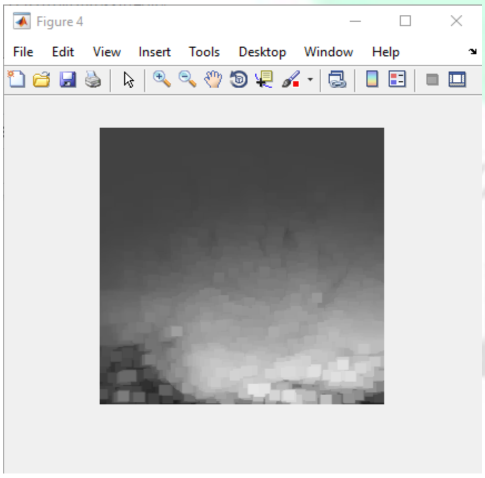



**Fig. 7**

The final enhanced image is restored using structure preservation prior and laplacian operator.

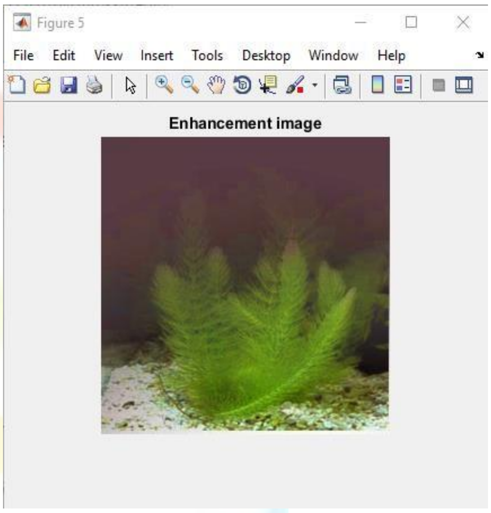
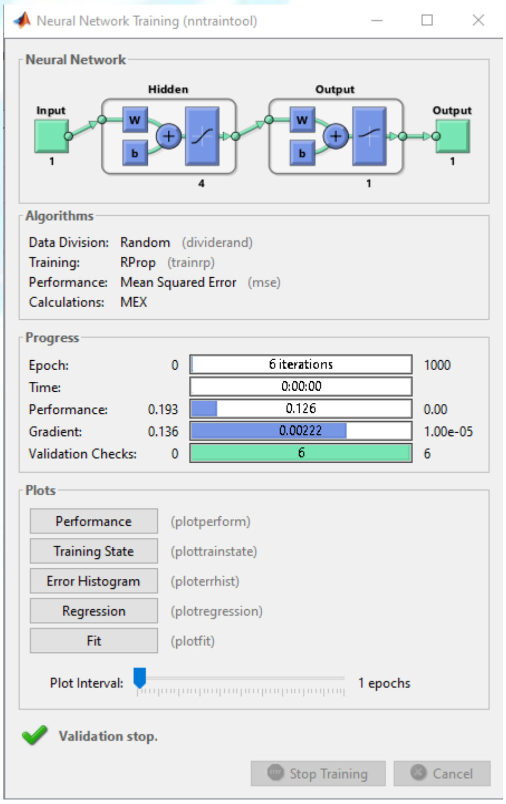



**Fig. 8**



International Journal of Advanced Development in Science and Technology

Volume : 3 Issue : 03 April 2021 www.ijadst.com e-ISSN: 2582-1059

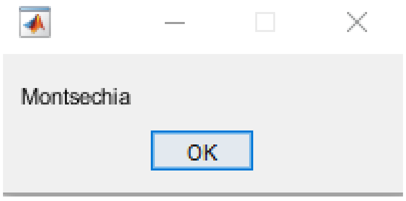



**Fig. 9**

### 7.1 CONCLUSION

In this paper a deep neural network based underwater image enhancement network is designed. However, when the system is trained it is able to correctly dehaze images in real time with only a still raw image as input. The results show that the system is able to generalize and learn to dehaze with images from a location. The method of image contrast enhancement on the basis of the contrast distribution at the boundaries of objects and background on the image is proposed. By using the neural network finally the botanical name of the plant is displayed with the database created.

In future work we will focus to place the dehaze frame in the input underwater video for better quality of underwater video and underwater images. We can further do a finer job on removing noise from the image. This method can also be used for other images for better and accurate haze removal.

### REFERENCES:

[1] B. Liu. and Q. Ling., "Edge-Guided Depth Image Super-Resolution Based on KSVD," in IEEE Access, vol. 8, 2017.

[2] Christian Osendorfer, Hubert Soyer, Patrick Smagt, “Image Super-Resolution with Fast Approximate Convolutional Sparse Coding,” Neural Information Processing, 2014, Volume 8836.

[3] CY Li, JC Guo, RM Cong, YW Pang, B Wang. Underwater Image Enhancement by Dehazing with Minimum Information Loss and Histogram Distribution Prior. IEEE Trans. Image Process. 2016; 25(12): 5664-5677.

[4] C. Ledig et al, "Photo-Realistic Single Image Super-Resolution Using a Generative Adversarial Network," 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Honolulu, HI, 2017.

[5] Dongsheng; Wang, Ruyi; Lu, Jian; Zhang, Qiang. 2018. "Depth Image Super Resolution Based on Edge-Guided Method" Appl. Sci. 8, no. 2: 298, 2018.

[6] E Kermani, D Asemani, A robust adaptive algorithm of moving object detection for video surveillance. EURASIP J. Image Video Process.

[7] J. Huang, A. Singh and N. Ahuja, "Single image super-resolution from transformed self-exemplars," 2015 IEEE Conference on

Computer Vision and Pattern Recognition (CVPR), Boston, MA, USA, 2015.

[8] K He, J Sun, X Tang. Single Image Haze Removal using Dark Channel Prior. IEEE Trans. Pattern Anal. Mach. Intell. 2011; 33(12): 2341-2353.

[9] M Ozaki, K Kakimuma, M Hashimoto, K Takahashi, Laser-based pedestrian tracking in outdoor environments by multiple mobile robots, in Proceedings of Annual Conference on IEEE Industrial Electronics Society 2011 (IECON, Melbourne, 2011), pp. 197–202

[10] N.Basty, D. McClymont, I. Teh, J. Schneider. E and Grau. V, "Reconstruction of 3D cardiac MR images from 2D slices using directional total variation" in Molecular Imaging Reconstruction and Analysis of Moving Body Organs and Stroke Imaging and Treatment, Cham, Switzerland, 2017

[11] R Gao, M Liu, X Fan, Y Wang. Fast Algorithm for Dark Channel Prior. Electron. Lett. 2014; 50(24):. 1826-1828

[12] R Fattal, Single image dehazing. ACM Trans. Graph. 72(3), 72:1-72:9 (2008)

[13] R T Tan, Visibility in bad weather from a single image, in Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR, Anchorage, 2008), pp. 1–8

[14] S G Narasimhan, SK Nayar, Contrast restoration of weather degraded images. IEEE Trans. Pattern Anal. Mach. Intell. 25(6), 713–724 (2003)

[15] S K Nayar, SG Narasimhan, Vision in bad weather, in Proceedings of the 7th IEEE International Conference on Computer Vision (ICCV, Kerkyra, 1999), pp. 820–827

[16] S Shwartz, E Namer, YY Schechner, Blind haze separation, in Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR) (CVPR, Anchorage, 2006), pp. 1984–1991

[17] YY Schechnner, SG Narasimhan, SK Nayar, Polarization-based vision through haze. Appl. Optics 42(3), 511–525 (2003)

[18] YY Schechnner, SG Narasimhan, Instant dehazing of images using polarization, in Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR, Kauai, 2001), pp. 25–332.