ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

Image Defogging by Dark Channel Prior Using RGB Colour Space

Kolli D V V Satya Rajesh[1], Prof.Kunjam Nageswara Rao[2], Sitaratnam Gokuruboyina[3]

M.Tech Student, Department of Computer Science & Systems Engineering, Andhra University, Visakhapatnam, Andhra Pradesh, India[1]

Professor, Department of Computer Science & Systems Engineering, Andhra University, Visakhapatnam, Andhra Pradesh, India[2]

Associate Professor, Department of Computer Science & Engineering, Lendi Institute of Engineering and Technology, Vizainagaram, India[3]

ABSTRACT: The quality of image is affected by environmental factors such as fog and it is difficult for automated systems to process and analyse the image as visibility is less. Image defogging method is used to get fog free images for better processing.The proposed method is used to calculate atmospheric light for the process of image defogging. This paper presents an image defogging method with efficient transmission map. The transmission mapis calculated for each channel of input foggy RGB(Red, Green and Blue) image. Transmission maps of each R, G, and B channels of the input foggy image are used to calculate a mean transmission map. Mean transmission map is improvedwithout loss of edge information using laplacian and mean filters to get better fog free image. Contrast improvement index, structural similarity index and fog effect are calculated and shows that the fog free images reconstructed using the proposed method are efficient. Experimental results show that reconstructed fog free image has good contrast, better visible quality which is efficient for processing and analysing.

KEYWORDS: Defogging, Dark channel prior(DCP),Atmospheric light.

I. INTRODUCTION

Image defogging is a method of removing the effect of environmental factors such as fog from images and to make image more visible which is required for image processing. It remove the fog from the foggy images so that reconstructed image looks more clear and visible.The perceptual quality of outdoor scene images is important for understanding and analysing the environment to perform automated tasks such as navigation, object detection and recognition. Scattering or absorption of light in adverse weather due to fog and haze can greatly restrict the visibility of outdoor scenes. Therefore, images taken in such weather conditions suffer from lower contrast, faded colours resulting in objects far from camera almost invisible. Effect of fog diminishes the visibility in acquired images. It can be seen that image degradation in such condition is due to the reflection and absorption of light by the fog particles. Since reduced visibility greatly effects the imaging systems, automated methods to enhance visibility in foggy images have become an area of interest. The fog effect depends on the depth of the object in a scene, i.e., the objects farther from the camera lose more information. To solve such problems, defogging technology is used. The models used to reconstruct enhanced images are categorized into two types, physical and non-physical models. Physical model is designed for observing physical causes that degrade the image and based on this model an inverse process is proposed to reduce the degradation level. Non-physical models are based on image processing techniques that enhance the image contrast and colour reconstruction without taking into consideration the factors which caused degradation. A dark channel (nonphysical model) based defogging method is used to get clear images. The dark channel is used to estimate the atmospheric light, the transmission map and is effective for defogging based on the observation that foggy images

ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

produce relatively higher intensities in the dark channel as compared to the clear images.It is applied to find the transmission map without any pre-processing or post processing. This paper presents an image defogging method based on DCP with an improved transmission map. Three transmission maps based on RGB channels are computed. The mean of three transmission maps obtained from RGB colour space is obtained which is termed as the mean transmission map. The mean transmission map is refined by preserving the edge information. Fog free mage is reconstructed using the transmission map.

II. RELATED WORK

Physical models offer the advantage of making local repair according to mist concentration in local regions of the image and offer good defogging results [1].The clear image is used and divided into small patches and get the lowest intensity values to obtain DCP. Atmospheric light estimation is not good [2]. The DCP based method produce result with low brightness, therefore, they proposed to increase the brightness of input image first and then estimate atmospheric light [3]. Observed that the patch size used for the calculation of dark channel had a major effect on DCP based method. They proposed an edge preserving method with large window size and performed patch-wise maximum operation after applying minimum operator to reduce haloes in the output image [4]. It was observed that DCP based method is not valid for images containing bright regions without adjusting the transmission map. For such images, atmospheric light is estimated using two different methods [5]. A parameter K is proposed to distinguish the sky from the rest of the image. The transmission map for sky is calculated separately, in addition to the original transmission map for non-sky area. It is observed that the low brightness in output image is due to smaller values of the transmission map, hence the parameter ‘p’ ranging 0.08 to 0.25 is added in the transmission map [6]. Proposed a method based on Fuzzy Logic Controller (FLC) that automatically estimates a threshold parameter to overcome the problem of bright region [7]. Morphological operations on the grayscale foggy image and then refined by utilizing guided filter for correct estimation of the atmospheric light. DCP method is applied to find the transmission map without any pre-processing or post processing, which results in low intensity in the defogged image [8]. Although the above mentioned techniques proposed improvements in image defogging in several ways, one or the other method still suffer from issues such as fog effect present in the image after defogging and lack of colour contrast in the image.

III. METHODOLOGY

A dark channel prior (DCP) based defogging method consists of five steps, i.e., dark channel prior, atmospheric light estimation, transmission map calculation, refinement of transmission map and reconstruction of fog free image as shown in Fig 1.

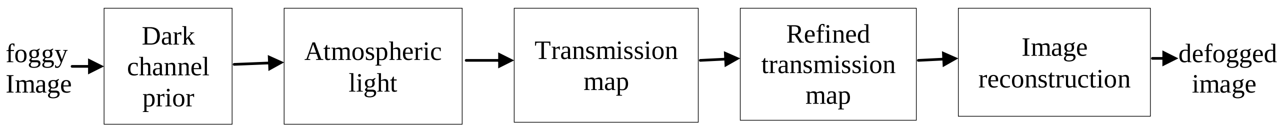

Fig 1: flow diagram of the proposed image defogging method using DCP in five stages

Image defogging using dark channel prior consists of five stages:

1. Construction of dark channel prior(DCP) using input foggy image:
Patch size of 21×21 is used. Apply minimum filter on the RGB images to obtain dark channel. First, the minimum filter is applied on each colour channels and then on the local patch of the resultant RGB image. Smaller patch gives an inaccurate estimation of the atmospheric lightcompared to large patch size, so 21X21 patch size is used for this purpose.

ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

Dark channel for the input foggy image is given as

$$D = \min_{n}(\min_{(C=R,G,B)} (I^{c}))$$

where D - Dark channel.
min - Minimum filter.
n - Patch size.
I^C - Pixel values of channel C of input image I.
C - Channel of the image, that is R,G,B.

2. Atmospheric light estimation:
Atmospheric light A is calculated from dark channelD. Locations of the brightest pixels are selected from D and get the highest pixel value from all the locations selected in each channels is obtained separately from these pixel locations. These three intensity values from the RGB channels are taken as atmospheric light A, A is a 3× 1 vector each value represents the highest intensity value in the each R, G, and B channel.

3. Transmission map:
The transmission map is computed using the atmospheric light A from the input foggy image. Every channel of input foggy image is divided by its corresponding value in A to compute three transmission channels. And then mean channel for input foggy image in RGB colour space is computed as

$$T = 1 – 1/3(SUM(_{C=R,G,B)} (I^{c}/A^{c)})$$

where T - Transmission map.
I^C - Pixel values of channel C of input image I.
A^C - Atmospheric light of channel C.
C - Channel of the image that is R, G, and B.
SUM - Sum of (I^c/ A^c) of each channel R,G,B.

4. Refinement of transmission map:
The transmission map is refined by preserving the information of the gradients. Laplacian filter is applied on the transmission map, and the output gradients are subtracted from the original transmission map to remove the unwanted noise. Then a mean filter is applied for smoothing. This process is applied to transmission map i.e., the mean transmission map for the RGB colour space.

Laplacian filter uses a mask 3X3 window as shown in Fig 2:

0	1	0
1	-4	0
0	1	0

Fig 2: 3X3 mask for laplacian filter.

ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

Mean filter uses a mask 3X3 window as shown in Fig 3:

1/9	1/9	1/9
1/9	1/9	1/9
1/9	1/9	1/9

Fig 3: 3X3 mask for mean filter

Applies on 3X3 sliding window of transmission map obtained after applying Laplacian filter. And the output of that is subtracted from transmission map in previous step. After applying above process on T obtained in previous step then the final refined transmission map T1 is formed.

5. Reconstruction of Fog Free Image:

Using the model designed by McCartney to represent the degradation mechanism due to fog in images we reconstruct the fog free image by

$$I = J * T + (1 - T) A$$

where I- Input foggy images.
J - Fog free image.
A - Atmospheric light.
T- Transmission map.

After computing all the parameters - I is input foggy image given, A from 2, T from 3, T1 from 4, the final step is to reconstruct the enhanced image with minimum fog. The image reconstruction process is given by

$$J= [[I - A] / \max (T1, T)] + A$$

whereJ - Final fog free image.

IV. EXPERIMENTAL RESULTS

For the input foggy image I Fig 4a, dark channel D Fig 4b, is computed by applying minimum filter first on each channel of the RGB and minimum filter is applied again on the filtered RGB image with local patch 21X21. Dark channel D is used obtained Atmospheric light A 3X1 i.e. by getting highest intensity value in each RGB channel from the location of the maximum intensity values of dark channel D. Transmission map T Fig 4c, is obtained by dividing each channel RGB with the corresponding value in A atmospheric light . Transmission map T is refined by applying Laplacian filter then subtracting it from the transmission map and then by applying mean filter to get T1. The final fog free image J Fig 4d, is constructed using above all parameters i.e. I, A, T, T1 using the model designed by McCartney to represent the degradation mechanism due to fog in images .we reconstruct the fog free image using J= [[I – A] / max (T1, T)] + A.contrast improvement index, structural similarity index and fog effect are computed for analysing the proposed defogging method.

ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

The above proposed method is applied on the foggy image a:


(a) Input foggy image (b) Dark channel


(c) Transmission map (d)Output fog free image

.

Fig 4: Steps involved in reducing fog from foggy image**.**

Performance evaluation:

Structural similarity index is a perceptual metric that quantifies image quality degradation caused by image processing. The performance of the proposed method is analysed by another metric calledfog effect. Comparison of the structural similarity index and fog effect for the proposed method with the existing methods is shown in Table 1. Lower the value of structural similarity index and fog effect signifies that reconstructed image has more reduced fog. The performance of the proposed method is also analysed by contrast improvement index. The comparison of the contrast improvement index value for the proposed method with the existing methods is shown in Table 1. The higher contrast improvement index value signifies better contrast improvement in the output image.

Metric	He method	Fattal method	Tan method	Tarel method	Wang method	Proposed method
Structural similarity index	0.8514	0.8686	0.6515	0.9119	0.6893	0.6321
Fog effect	14.6418	16.1377	11.7306	17.8932	12.4586	11.5242
Contrast improvement index	1.5372	1.4365	2.2342	1.2872	2.1421	2.3462

Table 1: Efficiency of proposed defogging method comparing with existing methods

ISSN(Online): 2319-8753
ISSN (Print): 2347-6710

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly, Peer Reviewed Journal)

Visit: www.ijirset.com

Vol. 8, Issue 8, August 2019

V. CONCLUSION

In this paper, the proposed image defogging method has been based on the dark channel prior (DCP).output of this method show results that the defogged images are good in contrast.The proposed method calculate the transmission map and utilized a Laplacian filter and mean filterto refine the transmission map. The proposed method estimates fog effect and the reconstructed images have better colour contrast. This method exhibit higher perceptual quality. This method shows better results for less to intermediate fog layer images but not for dense for images. There is scope that the proposed method may be improved to reconstruct fog free image from foggy image for better output image contrast and perceptual quality.

REFERENCES

[1] Z. Chen, J. Shen, and P. Roth, ‘‘Single image defogging algorithm based on dark channel priority,’’ J. Multimedia, vol. 8, no. 4, pp. 432–438, 2013.
[2] R. T. Tan, ‘‘Visibility in bad weather from a single image,’’ in Proc. IEEE Conf. Comput. Vis. Pattern Recognit., Jun. 2008, pp. 1–8.
[3] K. He, J. Sun, and X. Tang, ‘‘Single image haze removal using dark channel prior,’’ IEEE Trans. Pattern Anal. Mach. Intell., vol. 33, no. 12, pp. 2341–2353, Dec. 2011
[4] I. Riaz, T. Yu, Y. Rehman, and H. Shin, ‘‘Single image dehazing via reliability guided fusion,’’ J. Vis. Commun. Image Represent., vol. 40, pp. 85–97, Oct. 2016.
[5] E. Zhang, K. Lv, Y. Li, and J. Duan, ‘‘A fast video image defogging algorithm based on dark channel prior,’’ in Proc. 6th Int. Congr. Image Signal Process. (CISP), vol. 1, 2013, pp. 219–223.
[6] H. Xu, J. Guo, Q. Liu, and L. Ye, ‘‘Fast image dehazing using improved darkchannelprior,’’inProc.IEEEInt.Conf.Inf.Sci.Technol.,Mar.2012, pp. 663–667.
[7] L. Deng, O. Li, and S. Zhao, ‘‘An improved image defogging algorithm basedonglobaldarkchannelpriorandfuzzylogiccontrol,’’inProc.IEEE Wavelet Active Media Technol. Inf. Process., Dec. 2015, pp. 188–191.
[8] A.Kumari,S.Sahdev,andS.K.Sahoo,‘‘Improved single image and video dehazing using morphological operation,’’ in Proc. IEEE Int. Conf. VLSI Syst., Architecture, Technol. Appl., Jan. 2015, pp. 1–5.
[9] X. Chen, W. Sun, "A fast algorithm for single image dehazing based on estimating illumination veil", Proc. Int. Conf. Mechatronics Electron. Ind. Control Eng., pp. 987-991, 2015.
[10] 13. B. Yao, L. Huang, C. Liu, "Adaptive defogging of a single image", Proc. IEEE Int. Symp. Comput. Intell. Design, vol. 1, pp. 56-59, Dec. 2009.
[11] 14. M. J. Abbaspour, M. Yazdi, M. M. Shirazi, "A new fast method for foggy image enhancement", Proc. Iranian Conf. Elect. Eng. (ICEE), pp. 1855-1859, 2016.
[12] 15. J. P. Tarel, N. Hautiere, "Fast visibility restoration from a single color or gray level image", Proc. IEEE 12th Int. Conf. Comput. Vis., pp. 2201-2208, Sep./Oct. 2009.
[13] 16. I. Yoon, J. Jeon, J. Lee, J. Paik, "Weighted image defogging method using statistical RGB channel feature extraction", Proc. SoC Design Conf., pp. 34-35, 2010.