An Developed Picture Fogginess Method Supported on Dark Transmission Prior

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Abstract— Based on dark channel priority, the paper proposes an improved defogging algorithm of single image which can defog the foggy images rapidly. The algorithm in the paper applies the method combining adaptive median filter and bilateral filter to figure out clear dark channel on the edge. And the algorithm is based on the physical model of foggy images to estimate transmission. Compared with the traditional algorithm, the estimated transmission is detailed and clear, and has no need to be optimized, which not only overcomes the disadvantages of traditional algorithm using plenty of time to optimize transmission, but also reduces the complexity of the algorithm. The experimental results indicate that the algorithm realizes rapid and high-quality defogging on single image.

Key words: Image Restoration, Defogging, Dark Channel Priority, Adaptive Median Filter, Bilateral Filter, Image Defogging, Image Enhancement, Image Restoration, Dark Channel Prior

I. Introduction

Fog and haze are a common phenomenon on land and ocean. In foggy and hazy weather, there are many atmospheric particles of significant size. They not only absorb and scatter the reflected light of the scene, but also scatter some atmospheric light to the camera. Thus, the image acquired by the camera is degraded and usually has low contrast and poor visibility [1]. This will seriously influence the visual system especially the visible light visual system. Due to the degradation of the image, the targets and obstacles of the image are difficult to detect. This is bad for automated video processing, such as feature extraction, target tracking, and recognition of objects. This is also one of the main reasons for accidents in the air, on the sea, and on the road. So it is important to design an image defogging algorithm to improve the environmental adaptability of the visual system

A. *A Review of Previous Research*

Haze removal or dehazing is highly desired in both computational photography and computer vision applications. First, removing haze can significantly increase the visibility of the scene and correct the color shift caused by the airlight. Hongyu Zhao, Jing Yu, Chuangbai Xiao, and Xiujie Xu proposed a technique for single image fog removal based on Local extrema. The proposed method utilizes atmospheric scattering model to recognize the fog removal. It applies the local extreme method to figure out three pyramid levels to estimate the skylight and white balance, estimation of atmospheric veil, and image restoration by local extrema. The results on the experiments of comparison with traditional methods demonstrate that the projected method can achieve more precise restoration for the details and colors, resulting in a great improvement in image visibility.[1,2] Wei Sun proposed a technique for single image fog removal which is based on the physical model of atmospheric scattering and the optical reflectance imaging model, mainly three major factors which are going to affect the effect of fog removal are discussed in detail, dark channel phenomenon is explained via the optical model, and an approach for solving the parameter in the atmospheric scattering model is severely derived from a new perspective. Using fast joint bilateral filtering techniques and grayscale opening operation, the proposed algorithm can efficiently obtain the global atmospheric light and significantly improve the speed and accuracy of atmospheric scattering function solving. Finally, the scene albedo is recovered by inverting this model. [1,3]Tan's work is mainly based on the assumption that the clear-day images have higher contrast as compared to the input fog image, which has remove the haze by maximizing the local contrast of the foggy images. This method generates convincing images by enhancing the contrast, but it may also result in a physically-invalid extreme haze removal.[1,4] Tarel et al. presented a method for fog removal based on median filter. He used the median filtering method to estimate the atmospheric veil. This method performs faster than above methods. But still it has the limitation that its detail restoration is not ideal. Yu J et al. used the bilateral filter for the estimation of atmospheric veil. It will improve the performance of defogging. This method used to handle the two types of fields of unknown variables scene albedo and depth which is having a higher complexity. Based on planner road constraints, he introduces another efficient approach to improve the restoration of road area, here it assuming an approximately flat road. [1,5,6,7,8] Tripathi et al presented a technique for single image fog removal using bilateral filter. This filtering method is used to smooths the images without effecting the edges. In this proposed method, the given filter replaces every pixels of image by the weighted average of its neighbor pixel. This filter is used to get the quicker contrast. While using bilateral filter its uses the preprocessing and post transforming steps for the betterment. Histogram equalization is utilizes as a preprocessing and histogram stretching is utilizes as post preparing. [1,9]

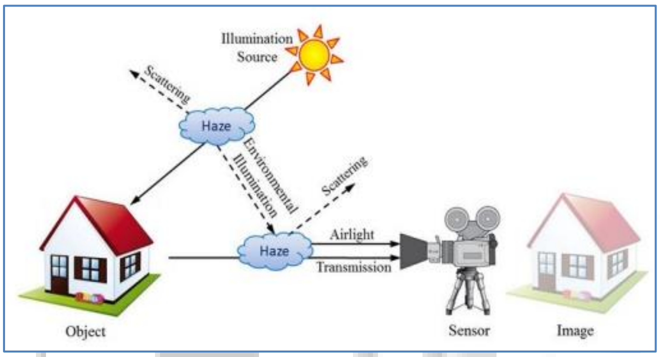
Fattal's approach is used for dehazing or defogging the image. This approach provides the impressive results. But it will not able to handle the heavy haze or heavy fog images when the assumption is not satisfied. Actually Fattal assumes that image albedo is a constant vector in local region and that the transmission is locally statistically uncorrelated. He proposed the dark channel prior to estimate the atmospheric veil by using the soft matting as a filter to refine it. But by using this method the space and time complexity is quite high. They further improve their method using some guided filter. [1,12,13]

II. THE ORIGINS OF FOG AND THE REMOVAL OF FOG

Poor weather conditions affect the visibility of external images. Having an atmospheric phenomenon such as fog or fog reduces image clarity. This type of decomposition is known as the effect of penetration. In many computer vision applications such as monitoring, automated vehicles, and object recognition, these images must be processed and the fog needs to be removed. This process is known to remove fog from the image.

In general, light reflected from the surface of the body is spread by liquid in the air such as fog, fumes, dust particles, etc. before reaching the capture device. This causes the image quality to deteriorate. Contrast is reduced and colors become less sharp and low. This observation is important in remote images taken by satellites, drones and so on.

Fog removal is very important in the various applications listed above, and it was a very difficult task for researchers to perform. The naive approaches of defogging many images of this particular scene taken in different climatic conditions included.



III. PROPOSED SYSTEM

Based on dark channel priority, the paper proposes an improved defogging algorithm of single image which can defog the foggy images rapidly. The algorithm in the paper applies the method combining adaptive median filter and bilateral filter to figure out clear dark channel on the edge. And the algorithm is based on the physical model of foggy images to estimate transmission. Compared with the traditional algorithm, the estimated transmission is detailed and clear, and has no need to be optimized, which not only overcomes the disadvantages of traditional algorithm using plenty of time to optimize transmission, but also reduces the complexity of the algorithm. The experimental results indicate that the algorithm realizes rapid and high-quality defogging on single image.

A. Defogging Algorithm based on Dark Channel Priority

Dark channel priority is the regularity obtained from the statistics on massive outdoor image without fog. As for most local area except for the sky , there are at least one color channel whose pixel brightness value approaches zero in three color channels of GRB. There are three major reasons, the shadow of architectures, people and vehicles, the projection of natural scenes such as trees and rocks, bright-colored objects such as red or yellow flower and leaf, green plant and blue water, and the pixel brightness value of some channels is very low in 3 channels of RGB which also has dark-color surface or objects such as the ground surface and stones. Above all, the scene without fog is full of color, dead colour or shadow, and has dark channels for image. However, brightness value of dark pixels for images disturbed by fog can be polluted by white light to become higher, that is, the higher the brightness value in ark channels except for the sky, the higher the density of fog in the position. So the dark pixels which are polluted by the fog can be used to estimate concentration of fog and transmission information of light.

B. Fog formation equation

The fog formation equation is given by

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

The variables are explained as follows
x = (x, y) is a coordinates (x, y) of a pixel's position
I is fog image observed
I(x) is vector at color of pixel
J is scene radiance
J(x) is reflection of light from point of scene x
t is transmittance of fog
t(x) scalar in [0,1]
A is global atmospheric light

C. Global atmospheric light estimation

The air light is used to generate the transmit map and allows us to determine the color of the aerial light. It is the proliferation of light in the atmosphere and inverted the map of transmission. To estimate the value of A, we first need to capture more blurry pixels in the input image and filter each color channel through the minimum moving window filter. A color channel with a maximum value is then an estimate of A

D. Estimating dark channel priority

In most spots where there is no sky, there are one or more color channels that contain some pixels whose intensity is too low or even closer to zero.

To accurately describe the dark channel, consider the J image and its dark channel, symbolized by j^{dark}, as shown

$$j^{dark}(x) = \min_{y \in \Omega(x)} \left(\min_{c \in \{r,g,b,\}} j^{c}(y) \right) \quad \text{--------(1)}$$

Where j^{c} is a single color channel for the image J and ((x) is a locally corrected x rectangle. Thus, dark channel is the result of the application of the minimum operators min c ε (r, g, b) and min y ε ((x), which is the minimum of the filter.

If J is an image free of fog in the air, the intensity of the dark J channel is almost zero is rough gray images

$$j^{dark} \text{->} 0 \quad \text{-------- (2)}$$

with checkerboard effect by taking Ω(x) as filter to make nonlinear minimum filtering on Jc of three channels. Each pixel ofj^{dark} is the minimum which is taken from three pixels of the corresponding position for 3 gray images. So according to dark channel priority, the intensity ofj^{dark} is always very low and approaches zero as for the area which is not the sky. I is used to show an atomizing RGB image, dark channels of I obtained according to Formula 1 is j^{dark} to which has rough gray image with checkerboard effect (see Figure 1b),

E. Calculating Transmission map

The transmission estimation method assumes that the transmission within the t (x) patch has a locally fixed value. We represent the transmission of the correction as l(x). The minimal implementation of the local debugging process gives

$$\min_{y\in\Omega(x)}\left(I^c(y)\right) = t(x)\min_{y\in\Omega(x)}\left(J^c(y)\right) + \left(1-t(x)\right)A^c \quad (3)$$

The equation is applied to all channels independently. The estimated transmission map of the fog image is almost good, but it has some effects on the mass since the transmission is not always fixed in the patch. serious halo trace appears at the edge of image after defogging(see Figure 1c). The reason is that transmission picture t is also rough (see Figure 1d). Because HE algorithm uses nonlinear minimum filtering in formula 1 in the process of calculating t, which results in checkerboard effect of t, HE algorithm applies image repair method to optimize the rough transmission diagram t. Although clear image can return after applying optimized transmission diagram t, the calculation of transmission diagram t is the biggest bottleneck for the algorithm. Side length value of Matting Laplacian giant matrix to be generated in the optimizing process is the area value of defogging images, and each element of Matting Laplacian matrix can be obtained by multiple cycle operation. By testing the image of 800×600 pixel, the whole calculation process takes about 103s, in which optimizing transmission diagram accounts for 94s. The above results are acquired from common PC which has the operating system with Windows XP, CPU with AMD quad core 3.0GHz and memory with 4G RAM. And using 2G RAM can result in memory overflowing, which makes optimization unable to be completed. The algorithm of optimizing transmission diagram is too complicated, which is the biggest obstacle to limit practicability of HE algorithm. However, the paper improves the algorithm which is improved in the paper reduces complexity of calculation significantly in the condition of not influencing the defogging effect, which can shorten runtime of the algorithm.

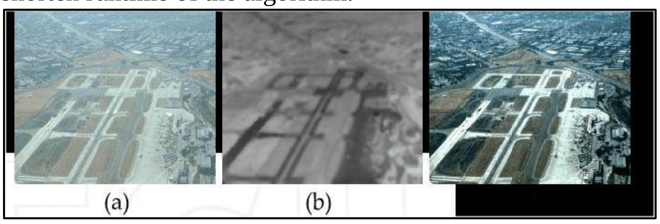


Fig. 1: image defogging

1) B Soft matting algorithm

Image matting is an extensive field, but in this paper I focus on foreground and background extraction. Given an image I, we wish to produce a matte (a trasparency value α at each pixel, with αi ∈ [0, 1]) such that at each pixel i we can deconstruct the color value Ii into a sum of two samples, one from a foreground color Fi and one from a background color Bi . To produce the color value at each pixel i in our original image, we then take Ii = αiFi + (1 − αi)Bi This problem is constrained with a "sketch" by the user, often called a prior, indicating regions of the image which are known to be either in the foreground or in the background. With enough such constraints, the problem can be sufficiently defined such that an accurate and useful matte is produced.

Fig. 2: A matting example.

From left to right: input image; user specified trimap matte; estimated foreground colors; a new composite. Results are generated by the Robust Matting algorithm [48].

2) System architecture

Here the architecture for digital image defogging by using dark channel prior and transmission map

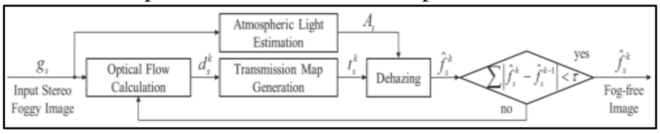


Fig. 3: System architecture

IV. CONCLUSIONS & FUTURE WORK

The paper proposed a defogging algorithm for single image based on dark channel priority which can make rapid defogging on foggy images. For the disadvantage of HE algorithm, that is, much time is used to optimize transmission diagram, the paper applies a method combining adaptive median filtering and bilateral filtering to calculate dark channels, The dark channels are refined, and transmission diagram t estimated by the method is also refined without need to optimize, which reduces the complexity of algorithm significantly and overcomes the bottleneck of low speed for HE algorithm. The algorithm realizes rapid and high-quality defogging on single images in the condition of not influencing defogging effect. The improved algorithm has flexibility, practicability and effectiveness, and makes the reliability of outdoor visual system in foggy weather improved dramatically, so it has widely practical value.

REFERENCES

[1] Radhika P. Yawale, A. S. Kapse, "A Review Towards Digital Image Defogging Using Dark Channel Prior and Histogram Stretching Method", IJARCCE, vol. 4, December 2015.
[2] Hongyu Zhao, Jing Yu, Chuangbai Xiao, and Xiujie Xu, "Single Image Fog Removal Based on Local Extrema", IEEE Journal of Automatica Sinica, vol. 2, 2015.
[3] Wei Sun, "A new single-image fog removal algorithm based on physical model", elsevier, pp. 4770-4775, 2013. [4]. Tan R T. "Visibility in bad weather from a single image", In: Proceedings of the 2008 IEEE Conference on Computer Vision and Pattern Recognition. Anchorage: IEEE Computer Society, pp. 1-8, 2008.
[4] Tarel J P, Hauti N. "Fast visibility restoration from a single color or gray level image", In: Proceedings of the 12th International Conference on Computer Vision. Kyoto, Japan: IEEE, pp. 20-28, 2009.
[5] Yu J, Li D P, Liao Q M. "Physics-based fast single image fog removal", Acta Automatica Sinica, 37(2): pp. 143-149,2011.

[6] Nishino K, Kratz L, Lombardi S. "Bayesian defogging", International Journal of Computer Vision, 98(3): pp. 263-278, 2012.
[7] Caraffa L, Tarel J P. "Markov random field model for single image defogging", In: Proceedings of the 2013 Intelligent Vehicles Symposium. Gold Coast, QLD: IEEE, pp. 994-999, 2013.
[8] Tripathi, A. K., and S. Mukhopadhyay. "Single image fog removal using bilateral filter", Signal Processing, Computing and Control (ISPCC), 2012 IEEE International Conference on. IEEE, 2012.
[9] Nayar S K, Narasimhan S G. "Contrast restoration of weather degraded images", IEEE Transactions on Pattern Analysis and Machine Intelligence, 25(6): pp.713-724,2003.
[10] Schechner Y Y, Namer E, Shwartz S. "Blind haze separation", In: Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. New York, USA: IEEE Press, Pp.1984-1991, 2006.
[11] He K M, Sun J, Tang X O. "Guided image filtering", In: Proceedings of the 2010 European Conference on Computer Vision (ECCV). Berlin, Germany: Springer-Verlag, pp.1-14,2010.
[12] Fattal R."Single image dehazing", ACM Transactions on Graphics (TOG), 27(3): pp.1-9,2008.
[13] Yan Wang, Bo Wu. "Improved Single Image Dehazing using dark Channel Prior", China, IEEE,2010.
[14] Mohini Sharma, Virender. "Single Image Dehazing using Improved Dark Channel Prior",Haryana,ACEEE,2013. [16]. 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, Aug. 2010.
[15] R. Fattal, "Single image dehazing," ACM Trans. Graph., vol. 27, no. 3, p. 72, 2008.
[16] K. Nishino, L. Kratz, and S. Lombardi, "Bayesian defogging," Int. J. Comput. Vis., vol. 98, no. 3, pp. 1–16, 2011.
[17] Yi-Hsuan Lai, Yi-Lei Chen, Chuan-Ju Chiou, Chiou-Ting Hsu,"Single-Image Dehazing via Optimal Transmission Map Under Scene Priors",IEEE, vol.25, no. 1, January 2015.
[18] J. Tarel and N. Hautiere, "Fast visibility restoration from a single color or gray level image," in Proc. IEEE Conf. Comput. Vis., Oct. 2009, pp. 2201–2208.