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A Survey on Image and Video Dehazing

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***Abstract*—**Most of the computer applications use digital images. Digital image processing acts an important role in the analysis and interpretation of data, which is in the digital form. Images and videos of outdoor scenes are mainly affected by the bad weather conditions such as haze, fog, mist etc. It will result in poor visibility of the scene caused by the lack of quality. It will make awful impact on applications like object detection, tracking and surveillance system. One of the major challenges is the restoration of actual original image from the degraded image with at most accuracy. This survey aims to study about various existing methods such as polarization, dark channel prior, depth map based method etc. are used for dehazing.

KEYWORDS: Haze, Polarization, Depth Map, and Contrast Maximization, Dark Channel Prior, Independent Component Analysis, Anisotropic Diffusion.

I. INTRODUCTION

Image quality is an essential requirement in any digital image applications for information extraction and analysis. Outdoor scenes and videos are often affected from the poor contrast caused by bad weather conditions such as haze, fog and mist etc. Haze is an atmospheric phenomenon where dust, smoke and other dry particles unclear the clarity of the sky[1]. It degrades the visual appearance of the scene. Haze removal with maximum accuracy is hard to achieve. So the problem can be simply defined as the restoration of original image by enhancing hazy images by constraining the information loss to least amount. Degradation may occur due to the scattering of the light which is based on phenomena such as attenuation and air light .Attenuation lessens the contrast of the scene whereas airlight enhances its whiteness[13]. Since it helps for many computer vision applications like object recognition it is very necessary to have an appropriate haze removal method.

II. DEHAZING METHODS

Dehazing methods can be categorized into two that are multiple image dehazing and single image dehazing.

A. Multiple Image Dehazing Methods

In multiple image dehazing method, haze removal [7, 9, 10] is carried out by taking multiple images of the same scene as input. These methods are explained below.

i. Method Based On Different Weather Condition

This method is to use multiple images [7, 10] of the same scene taken from different weather condition. The basic method is to take the differences of two or more images of the similar scene. These images have different properties of the contributing medium. This approach can significantly enhance visibility, but it is unable to handle a dynamic scene which is its drawback.

ii. Polarization Based Method

In this method multiple images of the same scene are taken with different polarization filters [9]. It varies in degree of polarization. This is acquired by rotating a polarizing filter attached to the camera, but the treatment effect of dynamic scene is not really good. The drawback of this method is that it cannot be applied to dynamic scenes for which the changes are faster than the filter rotation and require polarizer and not necessarily produce better results [6].

iii. Depth Map Based Method

It uses depth information for haze removal. It involves a single image and suppose that 3D geometrical model [7, 11] of the scene is provided by some databases such as from Google Maps. In addition to it also assumes the texture of the scene is given. Then it aligns with hazy image and provides the scene depth. This method needs user interaction to align this model with the scene and it generate accurate results. It does not require any special equipment's. Its drawback is that it is not automatic, because it requires user interactions. This method takes some amount of interactive manipulation to dehaze the image, but it requires an estimation of more parameters, and further information is difficult to obtain.

B. Single Image Dehazing Methods

This method only requires a single image as input [2, 4] which means it does not require any information from the additional images. This method depends upon statistical assumptions [3] and obtains the scene information based on the prior information from a single image. It does not require user interaction all the time. It does not need any separate hardware which gives it more attention. The methods come under this group are explained as follows.

i. Contrast Maximization Method

Haze affected region has less contrast than the other regions which are free from haze. Thus haze removal enhances the contrast of the image. Contrast maximization [3] is a method that maximizes the contrast under the constraint. But, the output images have larger saturation values because this method does not physically enhance the brightness or depth but restore the visibility. Moreover, the result contains halo effects at depth discontinuities.

ii. Independent Component Analysis (ICA)

ICA can be used to identify independent changing/moving parts in images and videos. ICA is a statistical and computational method to separate two additive components from a multivariate signal. Fattal [4] uses this technique and assumes that the transmission and surface shading are statistically uncorrelated in local patch. This method is physically valid and can produce good results, but may be unreliable because it does not work well for dense haze.

iii. Dark Channel Prior

The dark channel prior [3] is a sort of statistics of outdoor haze-free images. The key observation is that most local patches in outdoor haze-free images have some pixels (called dark pixels) whose intensity is very low in at least one color channel. These dark pixels aids the estimation of depth map with high quality .This approach using dark channel prior is physically valid and work well in dense haze. When the scene objects are like the air light then it is invalid.

iv. Anisotropic Diffusion

Anisotropic Diffusion is a technique is a technique that reduces haze without taking off the image parts such as edges, lines or other details that are needful for the comprehension of the image. Its flexibility allows combining image enhancement qualities with its smoothing properties. Tripathi [12] introduced an algorithm uses anisotropic diffusion for taking off air light map from dark channel prior. Besides it is used for smoothing the air light map. It performs well in condition of heavy fog.

TABLE 1: Comparison of dehazing methods

	Method	Demerits
Single Image Methods	Contrast Maximization	Halo effects at depth discontinuities
	ICA	Not good for dense haze.
	Dark Channel Prior	Invalid in the case of airlight like scene objects
Multiple Image Methods	Polarization	1.Require separate hardware ie. Polarizer. 2.Not necessarily produce better results
	Depth Map	cannot be applied to dynamic scenes
	Anisotropic Diffusion	Make edges harder to identify.

III. CONCLUSION

In this survey paper reviews various approaches for image dehazing. It is visible that most of the previously discussed techniques involve estimation of depth map which increases the time and computational complexities of their algorithms. This survey also shows a number of shortcomings and limitations of each and every method. The ccontrast enhancement method does not require this estimation and so is simple and fast. The various analyses proved that contrast enhancement based image dehazing [8] will create better results from any other techniques.

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REFERENCES

[1] http://en.wikipedia.org/wiki/Haze
[2] R. T. Tan, "Visibility in bad weather from a single image," in *Proc. IEEE Conf. Comput.Vis. Pattern Recognit.*,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] R. Fattal, "Single image dehazing," *ACM Trans. Graph.*, vol. 27, no. 3,p. 72, Aug. 2008.
[5] J. Tarel, N. Hauti, "Fast visibility restoration from a single color or gray level image",*Proceedings of IEEE Internation Conference on Computer Vision (ICCV), Kyoto, Japan:IEEE Computer Society*,2009, pp. 2201-2208.
[6] T. Treibitz and Y. Y. Schechner, "Polarization: Beneficial for visibility enhancement?" in *Proceedings of IEEE Conference Computer Vision Pattern Recognition*, 2009.
[7] Narasimhan, Srinivasa G. and Shree K. Nayar, "Contrast restoration of weather degraded images", *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 25, no.6,pp. 713-724, 2003.
[8] Cosmin Ancuti, and Codruta O. Ancuti,"Effective Contrast-Based Dehazing for Robust Image Matching" *IEEE Geoscience And Remote Sensing Letters,* Vol. 11, No. 11, Nov 2014.

[9] Schechner, Yoav Y., Srinivasa G. Narasimhan and Shree K. Nayar, "Instant dehazing of images using polarization", *The Proceedings of the IEEE Computer Society Conference on Computer Vision and Pattern Recognition (CVPR)*, vol. 1, pp. I-325, 2001.

[10] Nayar, Shree K. and Srinivasa G. Narasimhan, "Vision in bad weather ", *Proceedings of the Seventh IEEE International Conference on Computer Vision*, vol. 2, pp. 820-827, 1999.

[11] Narasimhan, Srinivasa G. and Shree K. Nayar, " Interactive (de) weathering of an image Using physical models " , *IEEE Workshop on Color and Photometric Methods in Computer Vision,* vol. 6 , no. 6.4, p. 1., France, 2003.

[12] Tripathi, and S. Mukhopadhyay, "Single image fog removal using anisotropic diffusion."*Image Processing*, Vol. 6, no. 7, pp. 966-975, 2012.

[13] http://www.ijcea.com/wpcontent/uploads/2014/06/RUCHIKA_SHARMA_et_al.pdf

[14] Cosmin Ancuti, and Codruta O. Ancuti, "image dehazing by multi scale fusion" *IEEE Geoscience And Remote Sensing Letters,* Vol. 11, No. 11, Nov 2014.

