Vision Enhancement through Single Image Fog Removal

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Abstract:- Image prior a simple and an effective method is proposed in this paper –for a single input image dark channel prior method is applied to remove fog. To remove fog from the out-door environmental images this dark channel prior plays an important role. While considering the out-door environmental images it is observed that in the image there will be equal intensive levels with one channel having lowest intensity. By this method to find fog using dark channel prior we can estimate the thickness of fog and get fog free image. Considering the results on more number of outdoor images it can be stated that dark channel prior is most suitable method to get better quality image in foggy environment.

I. INTRODUCTION

The outdoor images will be affected by natural phenomenon and by which the visibility will be degraded so that it makes poor visibility for people to see through (*e.g.*, particles, water-droplets) atmosphere. Due to scattering of light through Fog, Haze and smoke which make the scenario difficult for vehicles to pass. The irradiance received by the camera from the scene point is attenuated along the line of sight. Moreover the light *which will be* incoming will be blended due to air-light [6] (ambient light reflected into the line of sight by atmospheric particles).

To solve this problem mathematically equation number will be smaller but number of unknown parameter will be more which makes computation complicated. To resolve this mathematical complexity the solution is divided into two approaches. First approach is to get as much as variables which are known second approach is to add some assumptions or based on the scene to add some constraints. These both process can work based on only one image and this approach will give proper outcome. In this project we emphasize on fog removal based on single image technique which will be suitable for computer vision environments.

II. LITERATURE SURVEY

However, removal of fog is a difficult problem because the fog depth will be unknown and getting information about the depth will be challenging. Considering single image for fog removal is still difficult. Considering this many researches are going on globally with the help of multiple images of the same location and by using subtraction method to solve the fog problem. By using different degree of polarization applied on images we can remove fog with the help of multiple images but using these methods with different images we researches came across various weather changing conditions for the same scenario [2, 5, 7]. In recent development, removal of fog from single image [2, 8]is getting progress by using development of different algorithms. The better results will be seen by using different prior techniques which gives the strong support for detection of intensity of fog. In Tan [6] research he observed the image with no fog will have high contrast ratio compared to image which is having fog and he removed the fog by maximizing the local contrast of the reconstructed the image. The obtained results were though physically not valid but the images virtually were giving better results. Fattal [2] estimates the albedo of the scene and then infers the medium transmission, under the assumption that the transmission and surface shading are locally uncorrelated. Fattal's approach is physically sound and can produce impressive results. However, this approach cannot well handle heavy fog images and may fail in the cases that the assumption is broken. In this paper, we propose a novel prior **-** *dark channel prior*, for single image fog removal. The dark channel prior is based on the statistics of fog-free environmental images.

III. SINGLE IMAGE FOG ESTIMATION

The method to remove fog will consume much of the time which depends on various parameter, with this removal of fog is a very complex technique in many of the real time applications in computer vision. Taking these methods into consideration, here in this project we have considered two techniques. In initial methods, we use large kernel linear system to achieve a faster speed. In this method the experiment was away from conventional methodologies but it can be proved experimentally. Novel edge-aware filter is a second technique. The high-end techniques will be used for fog removal so the boarder elements will be considered in this method. This method which we have considered here are not only constrained to image processing but also this system works for the better visualization for human interface with environment.

A. Dark Channel Prior

The main consideration in this method was open space environment images which will give best texture and has many different natural colors. In this context as the image will have different texture the individual pixels will vary and the color channel intensity will also vary which will be a combination of one of the color channel in RGB.

$$J^{dark}(\mathbf{x}) = \min_{c\in\{r,g,b\}} \left(\min_{\mathbf{y}\in\Omega(\mathbf{x})} (J^c(\mathbf{y})) \right),$$

where *Jc* is a color channel of **J** and Ω(**x**) is a local patch centered at **x**. Our observation says that except for the sky region, the intensity of *Jdark* is low and tends to be zero, if **J** is a fog-free outdoor image. We call *Jdark* the *dark channel* of **J**, and we call the above statistical observation or knowledge the *dark channel prior*. Considering the outdoor environment in which the image is filled with shadow there are chances of images getting into wrong prediction.

B. De-noising and Defogging Separately

Simply de-noising the fog image as earlier to act on the defogging phenomenon is a usual criteria to overcome the complication of artifacts in scenario in recovering the image. Prior to defogging, image will be treated with model: **X** = **A**+**m**, in the action of the de-noising algorithm estimation of A is only required, gives information about fog scene. In contrast, de-noising as a post-processing step was determined with the help of Non-Local Means de-noising.

In actual transmission map and atmospheric light are generally not given, and so Fig. shows a simple block diagram for a more complete defogging algorithm. Given a noisy fogy image, it is first de-noised using BM3D. From this de-noised.

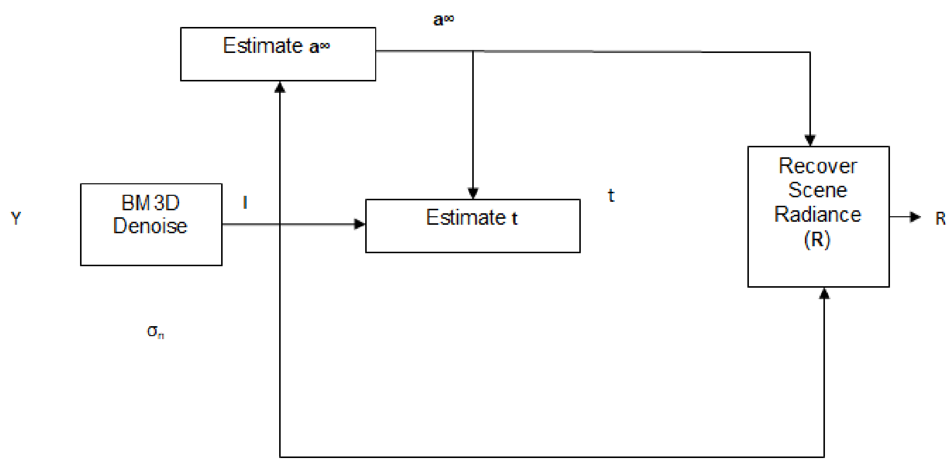

Fig 1:- First de-noised using BM3D

The noisy fogy image is first de-noised using BM3D given the noise standard deviation, *σn*. From the de-noised image, ˆ**I**, estimates for the environmental brightness (ˆ**b**∞) and transmission map (ˆ*k*) are found. Using these estimates, direct defogging is performed onˆ**I**, yielding the estimated scene radiance, ˆ**R.**

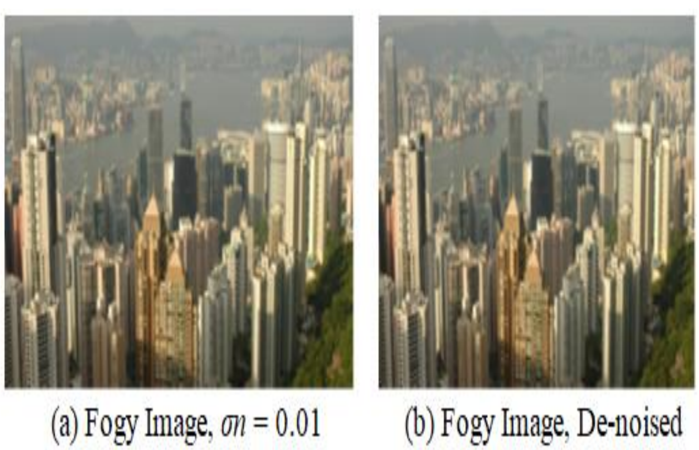

Fig 2

C. Estimating the Atmospheric Light

When compared with many of the existing methods for single image fog removal techniques, the opaque pixels of the fog which is caused due to environmental light will be estimated. For example, the fog with highest intensive levels will be considered as environmental light [10] and there after the image will be redefined [2]. If we consider the real time images then there may be pixels with high intensive levels like white car or white wall.

We can improve the environmental white pixel estimation by using dark channel estimation method. In dark channel initially we will consider the most intensive bright pixels with around 0.1.These 0.1% images which are high intensive will be considered as fog, these are environmental bright pixels by this we have to note that these pixels are not the brightest pixels considering the whole image. The originality of the dark channel prior method is much robust than the usual method of “bright pixel” theory. This method will automatically detect the bright pixels which will be followed in the current scenario.

ISSN No:-2456-2165

IV. EXPERIMENTAL RESULTS

This method was implemented using the local min operator using Marcel van Herk's fast algorithm [12] complexity of the algorithm ranges linearly with respect to the image. The image cell size is set between 10x10 for 500x300 images. Using soft matting method, Preconditioned Conjugate Gradient (PCG) algorithm as problem solving technique. Time consumed for processing took 7-12 seconds for processing 500x300 static image with PC working 2GB RAM Intel i3 processor.

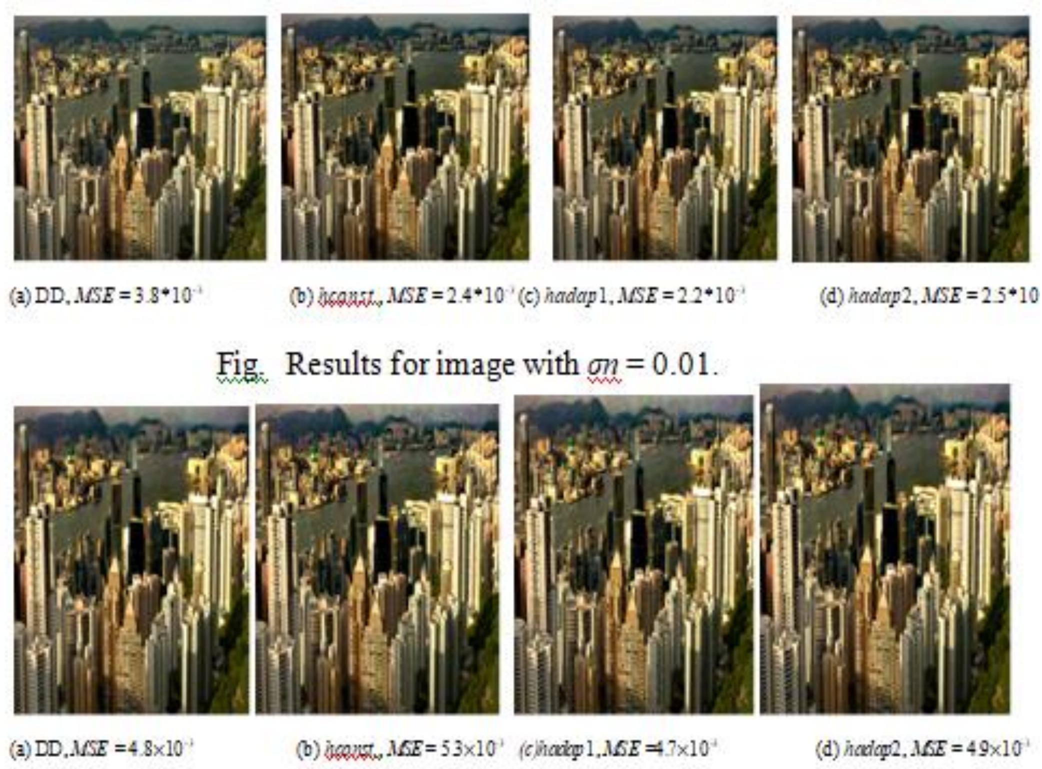

Fig 3:- with Different window size

Fig 4:- Original and Recovered Image

Image	Proposed	CLAHE
1	29.6295	21.5537
2	15.6306	13.3907
3	18.7055	15.5631
4	30.9249	18.8521
5	30.1627	12.3020
6	30.4773	22.9320
7	32.8009	26.4740
8	39.2061	20.0838
9	33.3717	18.6448
10	54.2921	18.5803
11	48.6955	4.6867
12	16.1642	15.0187
13	28.3293	19.1469
14	28.7890	15.7595
15	13.4581	10.3471

Table 1:- PSNR Ratio with proposed method

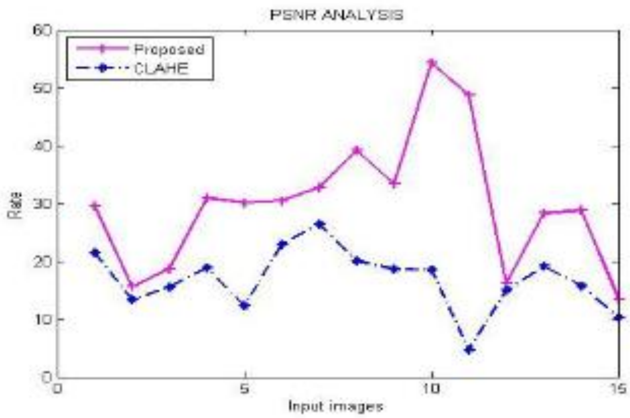

Fig 5:- Graphical Representation of PSNR

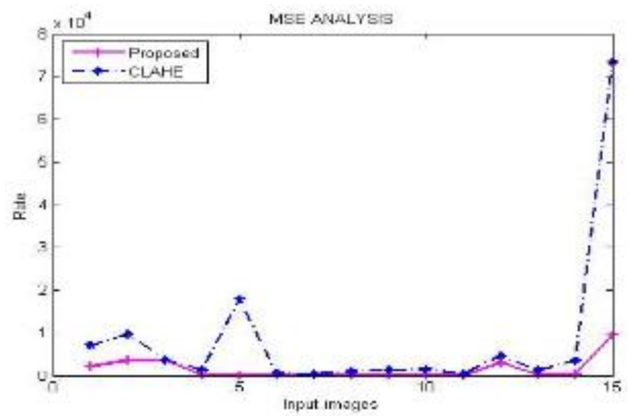

Fig 6:- Graphical Representation of MSE

V. CONCLUSIONS

Single image fog removal technique using dark channel prior method is proposed in the paper. Using this method we got know experimentally that it works fine not only with the particular images but also we got better results in outdoor environment too. This dark channel prior method when applied on fog images, the removal of fog appears to be good and effective. As the method considered is a static method it has its own cons like if the color in the image is white as the fog then there will be difficulty in analyzing the image and end up with inaccurate results.

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