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Image Haze Removal using Image Visibility Restoration &Edge Preserving Decomposition

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Abstract *– The limited visibility caused by fog and haze is a most important problem for several function therefore haze removal by these images for visibility improvement is necessary. In this paper, haze removal is done by make use of the dark channel prior procedure and estimation of the Atmospheric light technique. Dark channel region is calculated by using dark channel algorithm then the atmospheric variation is calculated on that dark channel region. The estimate of pixel value in the dark region and the atmospheric variation estimate is the estimate of transmission obtained as the transient image. Further the optimization of data is done by smoothing to obtain the radiant image or the dehazed image.*

Keywords*: Edge-preserving, edge-aware weighting, detail enhancement, haze elimination, exposure fusion,*

I. Introduction

This One of the foremost basic type's air pollution - haze is that the major reason for reduced visibility in several global city and scenic areas. Haze is caused when sunlight encounters little material within the air that reduces the clarity and color of what we have a tendency to see, and particularly during humid conditions. Computer vision purpose like video observation entity recognition, visual perception, tracking, intelligent vehicles and remote sensing arrangement etc, suppose that the input images have clear visibility but in many situations, haze and fog weather occur more frequently. Pictures or videos are typically degraded by light scattering and absorbing from the aerosols, like dust, mist, and fumes within the atmosphere, here regarded as haze. The captured scenes suffering from poor visibility, contrast, brightness, luminousness and hazy color. With the aid of atmospherically optics theories, one can justify the visibility of a scene and eventually of a picture taken that scene. Moreover, with the development of computer graphics technology, it's possible to enhance the visibility in terms of range, color incredibly similitude and feature separation in digital images. The term “dehazing” stand for provide a method to get a picture of a scene that doesn't contain haze-effects through the source of that image originally comprised haze. The guided filter allows a high-quality real-time stereo matching algorithm. A stereo technique is proposed in the guided filter which has been applied in optical flow measurement, interactive image segmentation, saliency recognition, and illumination rendering. The guided filter hasenormous potential in computer vision and graphics, because its ease, effectiveness, and high-quality.

Haze is an atmospheric phenomenon wherever turbid media obscure the scenes. Haze brings troubles to several pc vision/graphics applications. It reduces the visibility of the scenes and lowers the responsibleness of outdoor surveillance systems; it reduces the clarity of the satellite images; it additionally changes the colors and reduces the contrast of daily photos that is an annoying drawback to photographers. Therefore, removing haze from pictures is a vital and wide demanded topic in pc vision and computer graphics areas.

Our study on haze isn't limited in pc vision. The human visual system (HVS) is additionally faced with the inherent ambiguities in several vision issues, together with haze perception. However the HVS has good abilities to resolve these ambiguities. People have long complete that the only method the HVS might do so is to use certain priors [25]. However, most of those priors stay mysterious in psychology and physiology.

During inclement weather like fog, sand, and mist, captured pictures can exhibit degraded visibility. This can be because the suspended particles absorb and scatter specific spectrums of light between the observed objects and also the camera. Consequently, these degraded pictures will directly reduce the performance quality of systems like object recognition systems, obstacle detection systems, video surveillance systems, intelligent transportation systems, and so on. One among the foremost basic styles of pollution - haze - is that the main reason for reduced visibility in many global city and scenic areas. Haze is caused once daylight encounters very little material among the air that reduces the clarity and color of what we've a tendency to check, and particularly throughout humid conditions..

II. Theory

Pictures are the most common and convenient implies that of conveyance or transmission information. A picture is worth thousand words. Pictures in brief convey information about positions, sizes and inter relationships between objects. They portray spatial information that we'll acknowledge as objects. Human beings are smart at derivation information from such pictures, because of visual and mental skills. Regarding seventy fifth of the information received by human is in pictorial kind. A picture in hardware or some kind of storage media likes a hard disk or CD-ROM. This digitization procedure is completed by a scanner, or by a video camera connected to a frame grabber board during a portable pc. Once the image has been digitized, it's operated upon by varied image method operations. B. Xie [3].

Image process operations could also be roughly divided into three major categories, Compression, Image improvement and Restoration, and measure Extraction. Compression involves reducing the amount of memory needed to store a digital image. Image defects that will be caused by the digitization technique or by faults inside the imaging set-up (for example, bad lighting) could also be corrected using Image improvement techniques. Once the image is in good condition, the measuring Extraction operations are usually accustomed get useful information from the image.

III. Proposed Algorithm

III.1. DARK CHANNEL PRIOR

Please In research paper a new haze removal technique for a single input hazy image using dark channel prior with haze imaging model has been proposed. Firstly the haze image can be modeled by [5]

M(R) = N (R) k(R) + o (1 − k(R)) (I)
where,
M = Hazy image,
N= Scene radiance,
O = Atmospheric light,
k = Transmission light
R = position of the pixel within the image

The haze imaging model is shown in the figure below [8]

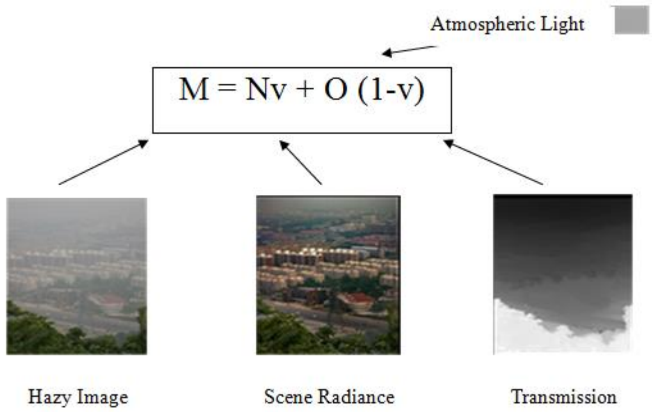

Fig 1 Haze imaging model

This can be further written on three color channels independently as [8].

$$\frac{M^C(R)}{O^C} = k(R)\frac{N^C(R)}{O^C} + 1 - k(R) \qquad \text{(II)}$$

Where,

M^c= atmospheric light of channel.
N^c = color channel of S and (P) is a local patch centered at P.
M_c= the dark channel output.
k(R)= the patch's transmission as

The transmission estimation from this normalized haze equation can be given by,

$$k(R) = 1 - \min_{y\in\Omega(R)}(\min_c \frac{M^C(y)}{O^C}) \qquad \text{(III)}$$

Where $\min_{y\in\Omega(R)}(\min_c \frac{M^C(y)}{O^C})$ is the dark channel of the normalized haze image $\frac{M^C(y)}{O^C}$.

Then the scene radiance is recovered by the following equation [8]

$$N(R) = \frac{j(R) - A}{\max(t(R), t_0)} + A \qquad \text{(IV)}$$

The value of p_o is 0.1 0
The achievement of newly developed procedure like [10], [08] evaluatedtodehazing techniques using assumptions. The Dark Channel previous technique by [8] He, Sun and Tang doesn't suppose important variance on transmission or surface shading within the input image and therefore the output image isless affected by halos than in [Tan, 2008]. though each assumption limits the algorithmic rule to specific use cases, the most assumption here appears to work for many outside scenes, aside from those wherever "the scene object is inherently like the air light over an oversized location and no shadow is cast on the object" [He et al., 2010a]. The dark channel S^{dark} of S (the haze-free image) is defined as [12]

$$N^{dark}(R) = \min_{c\in\{r,g,b\}}\left(\min_{y\in\Omega(R)}(N^C(y))\right) \quad (V)$$

Where N^c is a color channel of N and $\Omega(R)$ is a local patch centered at R. This statistical observation is called the dark channel prior.

III.2. ESTIMATE ATMOSPHERIC LIGHT

Most image dehazing algorithms need, for their operation, the atmospherically light-weight vector, \air, that describes the ambient light within the scene. Existing strategies either believe user input or follow error-prone assumptions like the gray-world assumption. This paper presents a new automatic methodology for recovering the atmospherically light vector in hazy scenes given one input image. The strategy 1st recovers the vector's orientation, L/||L||, by exploiting the abundance of little image patches within which the scene transmission and surface ratio are about constant. This paper shows that the magnitude of the atmospherically light vector, ||L||, cannot00 be recovered using patches of constant transmission, the corresponding channel of the atmospherically light is usually positive, the mathematical formula of the dark channel previous says most patches ought to contain dark pixels [8].

For outdoor haze-free images, most patches Ω (P) not covering the sky should satisfy:

$$\min_{c\in\{r,g,b\}}\left(\min_{R'\in\Omega(R)} N^c(X')\right) \approx 0 \quad (VI)$$

Or:

$$N_{dark}(x) \approx 0$$

This is called dark channel prior.It may be written:

$$N^{dark}(p) = \min_{c\in\{r,g,b\}}\left(\min_{y\in\Omega(R)} \frac{N^C(y)}{O^C}\right) = 0 \quad (VII)$$

In the above equation,

N^C

represents the dark channel of image S at pixel location P,

N^C

is a color channel of image S.

$y\in\Omega(R)$ = signifies all pixels y in a local patch around P.O^c = Atmospheric light

III.3. PSNR CALCULATION

Most PSNR is employ to compute the standard of rebuilding of lossy and lossless compression (e.g., for picture compression). In this case the original information, and also the noise is that the error initiate by compression. Once comparison compression codec's, PSNR is an estimate to human being observation of rebuilding quality. Though a higher PSNR usually indicates that the reconstruction is of upper quality, in some cases it should not. PSNR is most simply defined via the mean square error.

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

Where MSE= Mean Square Error.

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX^2}{MSE}\right)$$

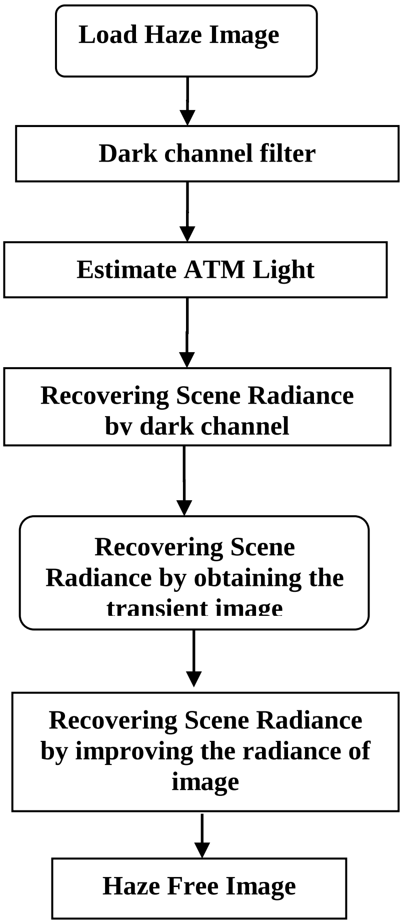

Fig. 2 flow diagram of proposed system

IV. Simulation Result

The images with the haze are analyzed and the following are the results.

Firstly we take the input image that is hazy image. The dark channel prior algorithm is applied on the hazy image then we obtain the dark image after haze removal. After applied the estimation of atmospheric light algorithm on dark image then we obtain the Recovering Scene Radiance by obtaining the transient image and Recovering Scene Radiance by improving the radiance of image.Lastly, we obtained the haze free image by applied proposed algorithm.

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Fig .3 Input images 1 with Haze

As show in above figure 3 is input image. In the above figure we can see the hazy image after taking input haze image we proposed the haze removal. In above input object apply dark channel estimation algorithm as show on equation 1 and 2 and find dark region and light intensity of object. After the collecting dark information in object we mark it as show in figure 4.

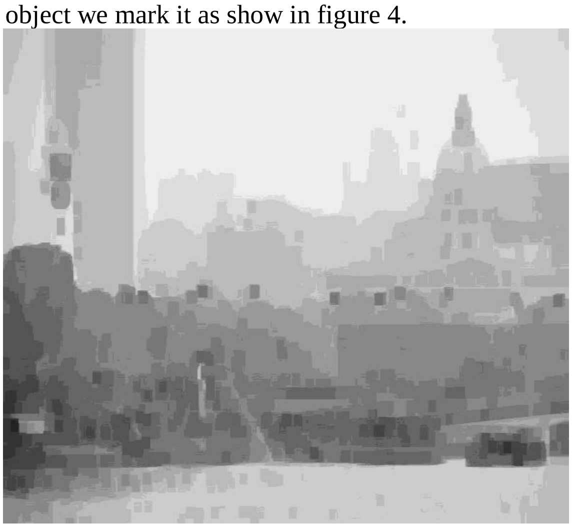

Fig .4 Dark image 1 after haze removal

The first output is a dark form of image after haze removal.After applied dark channel estimation, the atmospheric estimation and transient estimation algorithms on dark image. Then calculate variations as shown in figure 5. After that the process of estimation of atmospheric light (L) by the estimation of transmission (v) or choosing the brightest pixel in the dark region is done. The estimate of pixel value in dark region and the atmospheric variation estimate is the estimation of transmission obtained as the transient image fig.5.

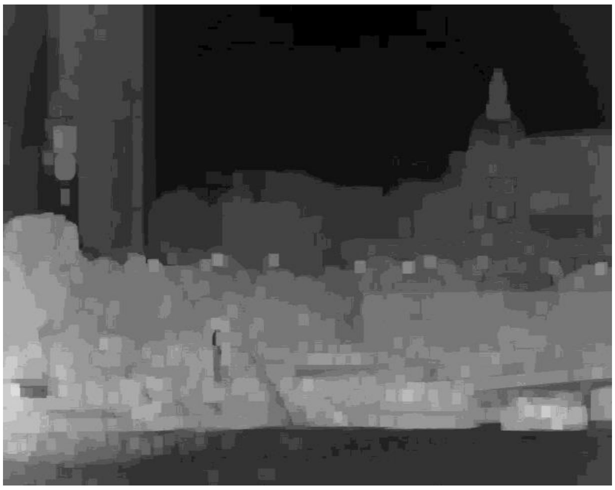

Fig. 5 transient image1 after haze removal

The scene radiance is then restored by improving the radiance of image. Marking of the dark region as the object and then recovering Scene Radiance & the object is identified in the hazy image. Scene radiance by obtain radiant image using proposed algorithm and shown in fig.6

Fig. 6 Radiant image 1 after haze removal

Fig.6 is the radiant or dehazed image of the object obtained.This image is optimization by smoothening the transient image after obtain the haze free image.The final output is a radiant image after haze removal.

Fig.7 Input image 2 with haze

Fig.8 Dark image 2 after haze removal

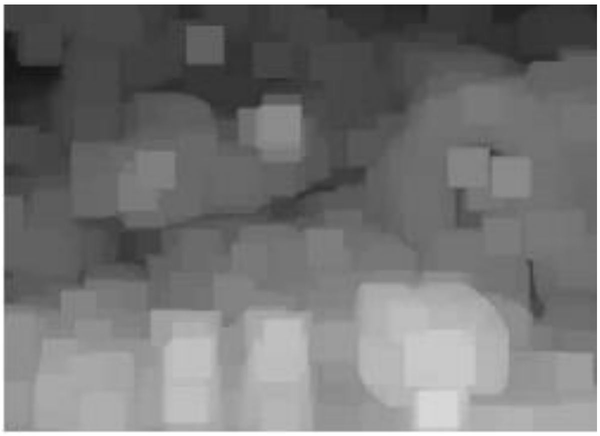

Fig.9 transient image 2after haze removal

Fig.10 Radiant image 2 after haze removal

Fig.11 Input image 3 with haze

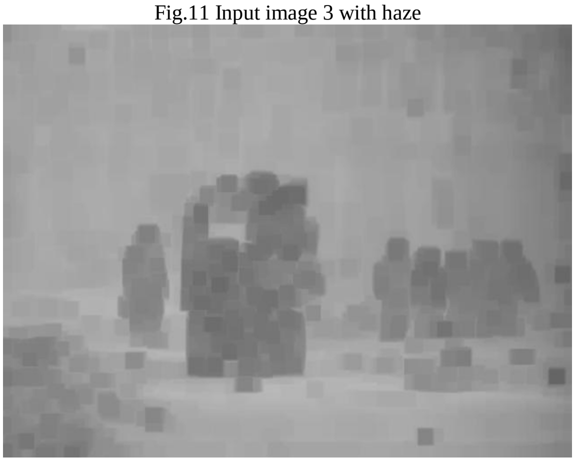

Fig.12 Dark image 3 after haze removal

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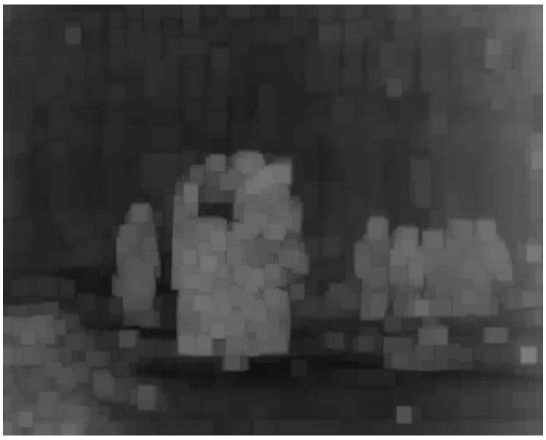

Fig.13 transient image 3 after haze removal

Fig.14 Radiant image 3 after haze removal

Table 1 Result Analysis

Input image	**Parameter**	**Base Paper**	**Proposed Algorithm**
Image 1	Size	600 × 450	500×500
	Running time	5.25	2.1 second
	PSNR	32 dB	38 dB
Image 2	Size	600 × 400	600 x 480
	Running time	10 second	1.1754 secs
	PSNR	50.25 dB	54.5160 db
Image 3	Size	2144×1424	2144×1424
	Running time	13.7 second	10 second
	PSNR	30 dB	35.89 dB

Input Image	Base Paper	Proposed Algorithm
		
		
		

V. Conclusion

A visibility restoration approach is planned so as to restore hazy pictures captured throughout haze, fog, sandstorms, and so on. In the visibility restoration module the adjusted transmission map and color-correlated information is produced severally by the depth information and color analysis. Explanation is around, Haze removal is proposed by means of the dark channel prior method and estimation of the Atmospheric light technique. Dark channel region is calculated by using dark channel algorithm then the atmospheric variation is calculated on that dark channel region. The estimate of pixel value in the dark region and the atmospheric variation estimate is the estimate of transmission obtained as the transient image. Further the optimization of data is done by smoothening to obtain the radiant image or the dehazed image.

The image after haze removal is obtained with the respective running time as given in table 1. The high quality haze free image is obtained as the result..

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