AN ADAPTIVE SINGLE IMAGE DEHAZING ALGORITHM

P.Bosebabu, Asst.Professor.
Shakeera Begum, K.Harshitha, Ch.Soumya
Students of Electronics and Communication Department,
Andhra Loyola Institute of Engineering and Technology, Vijayawada, India.

Abstract : The presence of haze in the atmosphere degrades the quality of images captured by visible camera sensors. The removal of haze, called dehazing. In this we propose a simple but effective image prior-dark channel prior to remove haze from a single image. . It is based on a key observation - most local patches in haze-free outdoor images contain some pixels which have very low intensities in at least one color channel. We can estimate the thickness of the haze and recover the haze free image. Using this prior we can easily estimate the depth maps, transmission maps and also the estimation of air light. Guided filter is used to estimate the thickness and air-light.

Index Terms- Dark channel prior, dehazing, guided filter, depth maps, transmission maps, air-light

I. INTRODUCTION

Due to absorption and scattering by atmospheric particles in haze, outdoor images have poor visibility under inclement weather. Poor visibility negatively impacts not only consumer photography but also computer vision applications for outdoor environments, such as object detection and video surveillance . Haze removal, which is referred to as dehazing, is considered an important process because haze-free images are visually pleasing and can significantly improve the performance of computer vision task. The incoming light is blended with the air-light (ambient light reflected into the line of sight by atmospheric particles). The degraded images lose the contrast and color fidelity.

First, removing haze can significantly increase the visibility of the scene and correct the color shift caused by the air-light. In general, the haze-free image is more visually pleasuring. Second, most computer vision algorithms, from low-level image analysis to high-level object recognition. , haze removal is a challenging problem because the haze is dependent on the unknown depth information. The problem is under-constrained if the input is only a single haze image. Therefore, many methods have been proposed by using multiple images or additional information. Polarization based methods remove the haze effect through two or more images taken with different degrees of polarization. In more constraints are obtained from multiple images of the same scene under different weather conditions. Depth based methods require the rough depth information either from the user inputs or from known 3D models.

Recently, single image haze removal has made significant progresses. The success of these methods lies in using a stronger prior or assumption. The haze-free image must have higher contrast compared with the input haze image and he removes the haze by maximizing the local contrast of the restored image. The results are visually compelling but may not be physically valid.

Fig. a)hazy image

fig. b)depth maps

Fig .c)transmission maps

fig .d)haze free image

II. DEPTH MAPS

Depth mapping of a hazy image can be done by comparing the low resolution pixel values with the high resolution values. Here the low resolution pixels are considered as the dark pixels and the high resolution pixels are considered as haze.

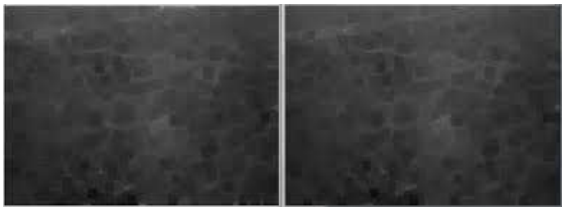

Fig.e) Depth map

III. DEHAZING

Removing of haze from the image is referred as dehazing. It is extremely required in client photography and computer perspective vision application. Dehazing can be grouped into two categories.

1. Multiple image dehazing method
2. Single image dehazing method

Multiple image dehazing method:-

During this particular haze elimination method, multiple or several images of the same scene will be taken.

Single image dehazing method:-

It relies upon statistical assumption to recovers the scene information based on the proceeding information from a single image.

DCP is a single image dehazing method. The methods used for single image dehazing are

1) Fusion based dehazing
2) Filter based dehazing

3.1) Fusion based dehazing

This type of method uses only the inputs and weights derived by original hazy image. The primary concept is to merge many input images into single one, keeping only the most significant features of them. It needs several images of the same scene. Due to high complication of time to remove haze, multiple image dehazing technique used that takes lesser time and just a single image per scene.

This method work by using three steps to remove haze.

Step1: Generation of two input images from original.
Step2: Defining weight measures.
Step3: Fusion of inputs and weight measures.

Step 1.Definition of Inputs: fusion based dehazing technique requires number of advices resulting from first image. The first input is received simply by undertaking white balance operation White balancing is most crucial stage which aims to enhance the image appearance by discarding undesired color cards, due to number of illuminations. The 2nd input is chosen to boost contrast in those regions which are suffering because of air-light influence.
Step2. Weight Measures:- This derived inputs tend to be proper measured through some weight maps. All these type of weight map try to help preserve the region along with great visibility. The Luminance weight map calculate visibility of every pixel.
Step3. Multi-Scale In practice, every input is decomposed into pyramid by applying Laplacian operator at different scales. Laplacian pyramid of image is produce by applying band pass filter followed by down sampling operation. As a band pass filter, pyramid construction tends to improve image features like edges, which plays most important role.

3.2) Filter based dehazing

There are four types of filtering based dehazing techniques. They are

1) Bilateral filter
2) Optimization based image filter
3) Guided filter
4) Weiner filter

In DCP we use guided filter to estimate the transmission maps and the air-light. We can also use the other filters but guided filter is more efficient than the other filters and it can easily estimate the transmission maps and air-light.

Block Diagram

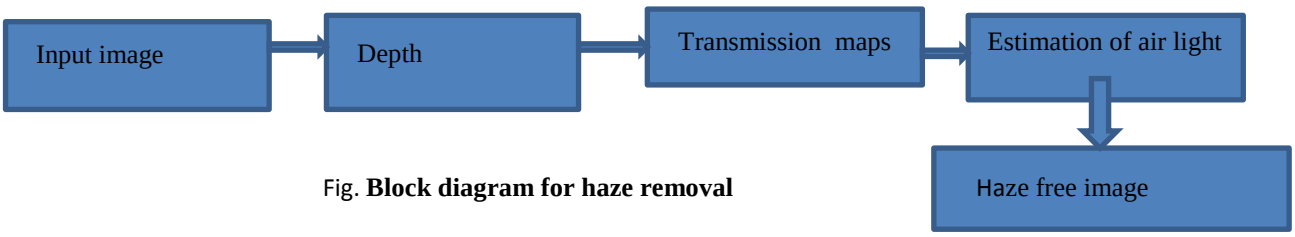

Fig. **Block diagram for haze removal**

3.3)Guided filtering:

Guided filter is a type of edge-preserving smoothing operator, which filters the input image under the guidance of another image [5]. Denote the input image as p, the guidance image as I, and the filtering output as q. The local linear model of guided filter assumes that q is a linear transform of the guidance I in a window wk centered at pixel k, so that mathematically we have:

$q_i = a_k I_i + b_k, \forall i \in w_k,$ Eq.1

in which the linear coefficients ak and bk are constant in window wk, we also denote the radius of the window wk as r. Guided filter seeks for coefficients (ak, bk) that minimizes the difference between the output q and the input p. For a window wk, consider the cost function:

$E(a_k, b_k) = \sum_{i \in w_k} ((a_k I_i + b_k - p_i)^2 + \epsilon a_k^2),$ Eq.2

where ϵ is a regularizer

For RGB color guidance image, the derivations are similar . As can be seen that locally, the output q captures similar details from the guidance I (by virtue of the local linear model (1)); while globally, the impression of the output q should be similar to the input p (due to the minimization of the cost function (2)

3.2.3.1) Transmission maps:

The transmission map and atmospheric light have important roles in haze removal. Guided filter is used to estimate the transmission maps. To find the transmission maps the 'r' value should not be high or low, it should be constant. Transmission maps alleviate the blocking effect and enhance the image details.

Fig. f) Transmission maps

3.2.3.2)Estimation of air light:

The atmospheric light 'A' is estimated from the most haze-opaque pixel. For example, the pixel with highest intensity is used as the atmospheric light .But in real images, the brightest pixel could on a white car or a white building. It is calculated by dark channel prior with a fixed size window. If the minimum filtering is done using too small window, then it may pick up extra light sources in the image, which can corrupt the estimation. When using a window size of 15 in image, the atmospheric light will be corrupted and if it increased to 31, the atmospheric light will be properly estimated amongst the pixels.

Fig. g) estimation of air-light

IV DARK CHANNEL PRIOR

This technique is actually useful for single image dehazing. It is used to measure the statistics of the outdoor fog free image. Imagine that there are few pixels having very minimal intensity in any one of the color channel. These pixels are called dark pixels. These dark pixels are used to calculate the transmission map. Transmission map is used to eliminate some blocky effect. Single image is utilized for restoration

of foggy image so that Transmission map is estimated accurately. Basically, the minimum intensity in such a patch need to have very minimum value.

Dark channel is calculated by,

$$dark(x)=\min\{\min\{Jc(y)\}\} \qquad \text{Eq.3}$$

$y \in \Omega(x)$ $c \in \{r,g,b\}$ Where J' is a color channel of J and Q(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 haze-free outdoor image. We can say Jdark the dark channel of J, and we call the above statistical observation or knowledge the dark channel prior. Both transmission t and atmospheric light A can be obtained by the DCP based method. After a refinement on transmission, which is discontinuous because of the two discrete minimum operations, the scene radiance can be recovered from,

$$J(x) = I(x) - A / \max\{t(x), t_0\} + A \qquad \text{Eq.4}$$

$$t(x) = e^{-\beta d(x)} \qquad \text{Eq.5}$$

where t_0, is a lower bound which has typical value 0.1, which introduced to make this algorithm more robust to noise. The low intensities in the dark channel are actually due to shadows or colorful objects. Based on the DCP, the dehazing is accomplished through four major steps atmospheric light estimation, transmission map estimation, transmission map refinement, and image reconstruction.

V. **RESULTS**

The resolution of the image is 600x400 (fog)

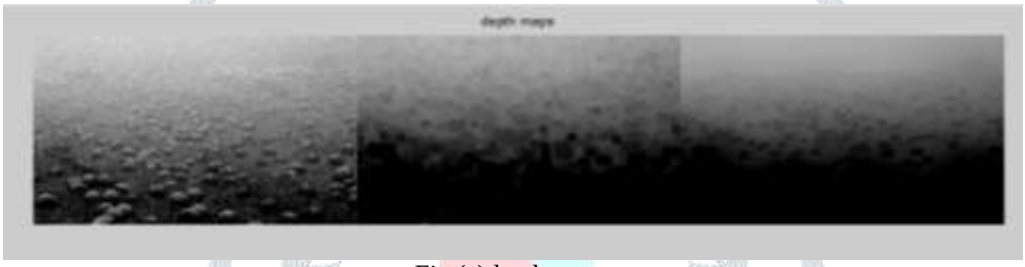

Fig.(a)depth maps

Fig.(b)transmission maps

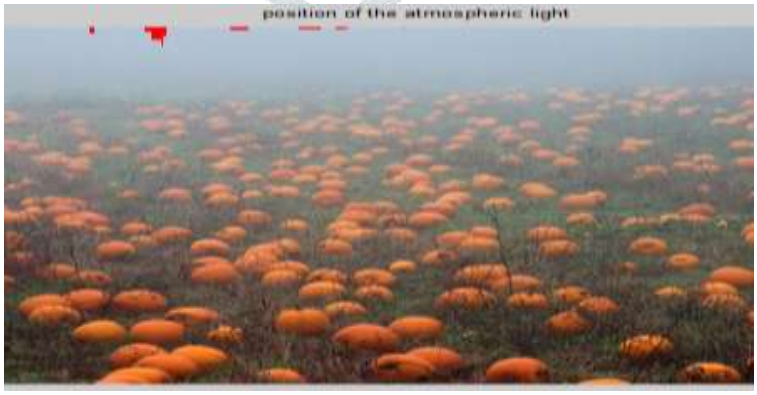

Fig.(c)estimation of air-light

Fig.(d) hazy image and dehazed image

The resolution of the image is 650x366 (smog)

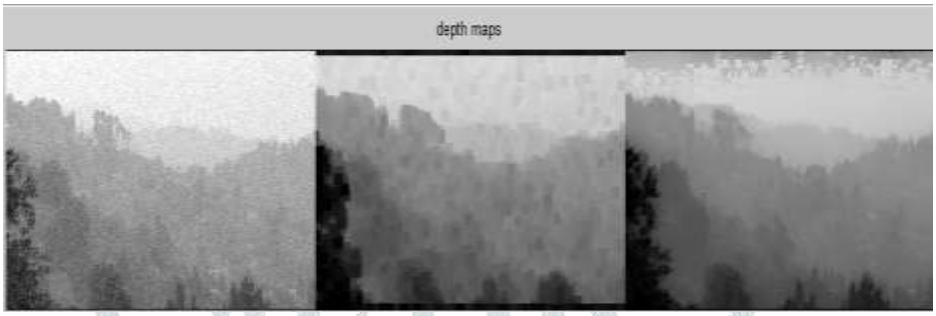

Fig.(a)depth map

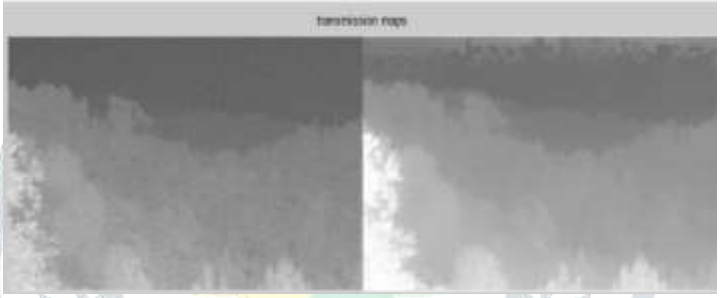

Fig.(b)transmission maps

Fig.(c)estimation of air-light

Fig.(d) hazy image and dehazed image

VI. CONCLUSION

In this paper we have discussed the image haze removal techniques which play a significant role in several regions of vision processing. Many real-time applications suffer with poor contrast problem because of haze or fog. Some environmental effects for example haze, fog, smoke, dust etc, effect very poorly the quality of the received picture. Image haze removal techniques have taken restoration value statically, that depends upon the given set of images that limits the performance of fog removal method as restoration. This value needs to be adaptive as effect of haze on given image varies scene to scene and atmospheric veil. The presented methods have neglected the use of multi-objective optimization techniques to improve the adaptivity of the digital haze removal algorithms. So, in future, we will propose multi-objective Differential Evolution based optimization for image defogging using contrast gain and percentage of saturated pixels.

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VIII.REFERENCES

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