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Image Defogging By Using Color Depth Maps Technique

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ABSTRACT:
The problem of foggy removal has a long and well-travelled history. Defogging from a single input foggy image is very challenging. This is because we have a little knowledge about the image. Since concentration of the foggy image is different from place to place it will become very hard to detect foggy in image. The proposed work is a fast single image foggy removal technique and it works by using color depth maps technique. This method removes foggy progressively. A linear model is created and the depth map is produced by using that model. From depth map, the transmission is estimated and the scene radiance is restored. Thus foggy can be removed efficiently. Experimental results show that color depth maps model will work more efficiently than state-of-art haze removal algorithms.

***Keywords:* Defogging, depth map, transmission diagram, scene radiance.**

I. INTRODUCTION

Outdoor scene of image quality is degraded due to the poor weather condition such as haze, fog, mist and smoke. It also degrades due to the presence of foggy when the image is taken from outdoor using digital camera. It means light gets scattered before reaching the camera due to the noise present in the atmosphere. So haze removal is critical problem. In poor weather conditions de-foggy the image is very critical issue in applications such as aerial photography, image recognition, driving assistance and visual surveillance. So the defogging the image using our method to improve contrasts of the foggy images and restores the visibility of the scene.

Hence removal of fog requires the estimation of air light map or depth map. Image enhancement and image restoration are the two techniques used in the haze removal image. The foggy image leads to loss of information instant of using the enhancement techniques.Image refurbishes the study of the physical process of imaging in fog. Enhancement is usually used in the following three cases: noise decreases from image, contrast enhancement of the really dull and bright image, and show up the boundaries of the substance in a blurring image. Noise decrease is the method of reducing noise from a signal or an image. In general, images occupied with both digital camera and conventional film cameras will choose noise from a multiple sources. Contrast enhancement is capturing clear image from closer intensities.

An overview of the proposed defogging method is shown in fig.1.

Fig.1.defogged method

Top-left: Input hazy image. Top-right: Restored depth map. Bottom-left: Restored transmission map. Bottom-right: Dehazed image

2. LITERATURE SURVEY ON EXISTING WORKS

Foggy or Haze removal methods can be grouped into two categories that are multiple haze removal and single haze removal. Here we are discussing a few single haze removing methods.

This method only requires a single input image. The literature survey is focused on most relevant papers in this area.

2.1. Visibility in Bad Weather from a Single Image

Haze diminishes the contrast. Removing the haze enhance the contrast of the image. This paper proposes a contrast maximization method [1]. Contrast maximization is a method that enhances the contrast under the constraint. In this method, the following computational steps are performed.

Step1: The given input image the algorithm estimates the atmospheric light. This can be done by finding a small spot that has the highest intensity in the image.
Step2: compute the light chromaticity. However, to be more accurate, estimate it using an existing color constancy method.

This method has number of disadvantages. The resultant image has larger saturation values because this method does not physically improve the brightness or depth but somehow it enhances the visibility. Moreover, the result contains halo effects at depth discontinuities.

2.2. Single Image Dehazing

This paper [2] presents a new method for estimating the optical transmission in hazy scenes given a single input image. Based on this estimation, the scattered light is eliminated to increase scene visibility and recover haze-free scene contrasts. Independent component analysis is the method used in this work. Independent component analysis is a statistical method to separate two additive components from a signal. This approach is physically valid and can produce good results, but may be unreliable because it does not work well for dense haze.

2.3. Single image haze removal using dark channel prior

This work [3] proposes a simple but effective image prior – dark channel prior to remove haze from a single input image. It is based on the observation – most local patches in haze-free outdoor images contain some pixels which have very low intensities in at least one color channel. In the haze image, the intensity of these dark in that channel is mainly contributed by the air light. So by using this pixel it can directly provide accurate estimation of the haze's transmission. The dark channel prior may be invalid when the scene object is inherently similar to the air light over a large local region and no shadow is cast on the object.

2.4. An Improved Single Image Haze Removal Algorithm Based on Dark Channel Prior and Histogram Specification

This work [4] combines dark channel prior (DCP) and histogram specification. The intensity histogram, which is usually the only information for a gray scale image, indicates the probability of every gray value of the pixel. It can conveniently obtain the contrast and intensity information of one image by analyzing the histogram.

3. IMAGE ENHANCEMENT

A process of enhancing the visual quality of images due to no ideal image acquisition process (e.g.,poor illumination, coarse quantization etc.)The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. It accentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more help full for display and analysis.

The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can

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be detected easily the greatest difficulty in image enhancement is quantifying the criterion for enhancement and, therefore, a large number of image enhancement techniques are empirical and require interactive procedures to obtain satisfactory results. Enhancement methods can be based on either spatial or frequency domain techniques.

4. PROPOSED WORK

In this paper, is proposed a novel color depth maps technique for single image defogging. This simple and powerful prior can help to create a linear model for the scene depth of the foggy image. By learning the parameters of the linear model with a supervised learning method, the bridge between the foggy image and its corresponding depth map is built effectively. With the recovered depth information, can be easily removed the foggy from a single foggy image. An overview of the proposed defogging method is illustrated in fig1.The efficiency of this defogging method is dramatically high and the defogging effectiveness is also superior to that of prevailing defogging algorithm shown in fig.2.

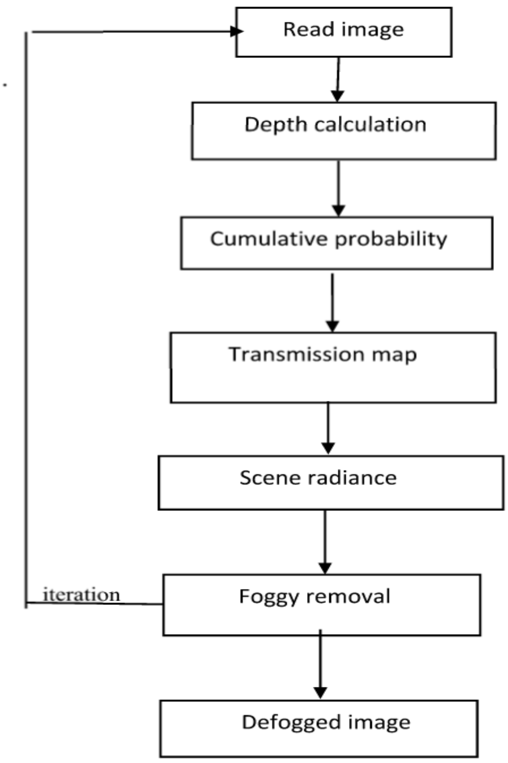

Fig: 2. Flowchart

5. ATMOSPHERIC SCATTERING MODEL

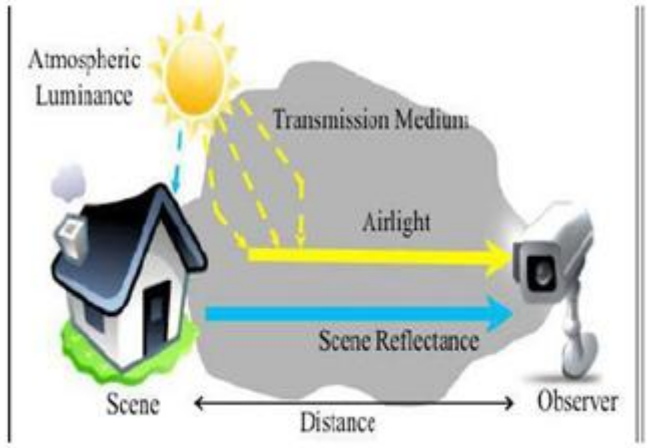

Fig: 3 atmospheric scattering model

The model as shown in fig 3 can be expressed as follows:

$$I(x) = J(x)\, t(x) + A\,[1 - t(x)] \quad \text{------} \quad (1)$$

$$t(x) = e^{-\beta\, d(x)} \quad \text{----------} (2)$$

Where x is the position of the pixel within the image, **I** is the hazy image, **J** is the scene radiance representing the haze-free image, **A** is the atmospheric light, t is the medium transmission, is the scattering coefficient of the atmosphere and d is the depth of scene. **I**, **J** and **A** are all three dimensional vectors in RGB space. Since **I** is known, the goal of dehazing is to estimate **A** and t, then restore **J**.

It is worth noting that the depth of the scene d is the most important information. Since the scattering coefficient ß can be regarded as a constant in homogeneous atmosphere condition, the medium transmission t can be estimated easily according to Equation if the depth of the scene is given. Moreover, in the ideal case, the range of $d(x)$ is $[0, +\infty)$ as the scenery objects that appear in the image can be very far from the observer, and we have:

$$I(x) = A, \quad \text{---------------} (3)$$

$$\text{as, } d(x) \to \infty$$

Therefore, instead of calculating the atmospheric light A by Equation (3), we can approximation A by the following equation given a threshold $d_{thresold}$:

$$I(x) = A, \quad d(x) \geq d_{thresold} \quad \text{--------}(4)$$

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Based on this hypothesis, the atmospheric light A is given by:

$$A = I(x), x \in \{ x | \forall y: d\, y \le d(x)\}. \quad \text{----- (5)}$$

6. COLOR DEPTH MAPS TECHNIQUE

To distinguish or expel the fog from a solitary picture is a testing assignment in PC vision, since little data about the scene structure is accessible. Regardless of this, the human mind can rapidly recognize the cloudy region from the characteristic view with no extra data.

The proposed method works progressively and it is based on color depth maps technique. A large number of experiments are conducted on fogged image and reaches a conclusion that in a foggy image brightness and saturation of a pixel vary sharply along with the change of foggy concentration. In the presence of haze, saturation decreases and brightness increases. So the difference between saturation and brightness increases. When the concentration of foggy increases then the difference will also increase.

$$d(x) \propto c(x) \propto v(x) - s(x) \quad \text{----- (6)}$$

Where *d* is the scene depth, *c* is the concentration of the haze (foggy), *v* is the brightness of the scene and *s* is the saturation. This approach is named as color depth maps technique. Figure 4 gives the geometric description of the color depth maps through the HSV color model.

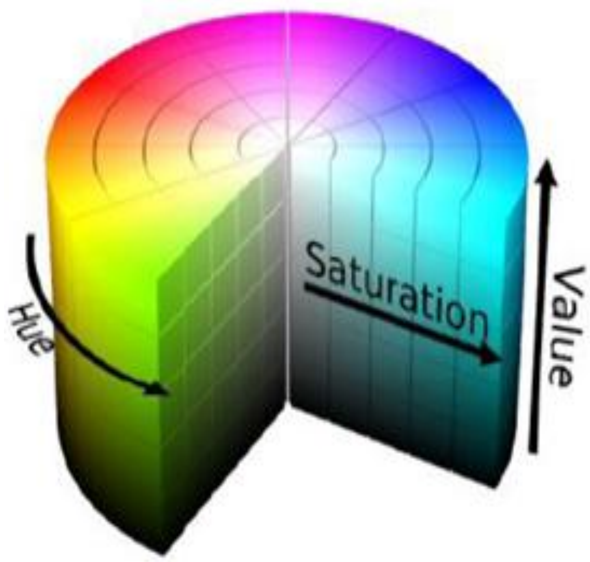

Fig: 4 HSV color model

7. SCENE DEPTH RESTORATION

7.1 Linear model training data collection

From these results a linear model is constructed and parameter in that model is learnt by using statistical model. The linear model used in this work is described as:

$$d(x) = \theta_0 + d\,\theta_1 v(x) + \theta_2 s(x) + \varepsilon(x) \quad \text{------(7)}$$

Where x is the position within the image.
d is the scene depth.
v is the brightness component of the hazy image.
s is the saturation component.
θ_0, θ_1, θ_2 are the unknown linear coefficients.
$\varepsilon(x)$ is a random variable expressive the random error of the model.
ε can be regarded as a random image.

7.2 Training data collection

Training is done on a sample consist of a hazy image and depth map. After the training we get the values of constants. So by using the above model scene depth is calculated. From depth map the cumulative probability, the transmission map and the scene radiance are calculated. Using all this information it is possible to remove foggy from hazy image.

8. SCENE RADIANCE RECOVERY METHOD

8.1 Estimation of the atmospheric light

As the depth map of the input hazy image has been improved, the allocation of the scene depth is known. Bright regions in the map stand for distant places. According to Equation (5), pick the top 0.1 percent brightest pixels in the depth map, and select the pixel with maximum intensity in the corresponding hazy image among these brightest pixels as the atmospheric light A.

8.2 Scene Radiance Recovery

Now that the depth of the scene *d* and the atmospheric light Aare known, it can estimate the medium transmission *t* simply according to Equation (2) and improve the scene radiance J in Equation (1). For ease, rewrite Equation (1) as follows:

$$J(x) = \frac{I(x) - A}{t(x)} + A = \frac{I(x) - A}{e^{-\beta d(x)}} \quad \text{---------- (8)}$$

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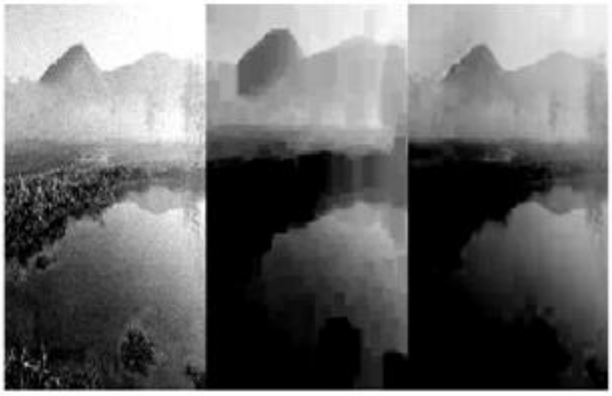
9. RESULTS AND DISSCUSION

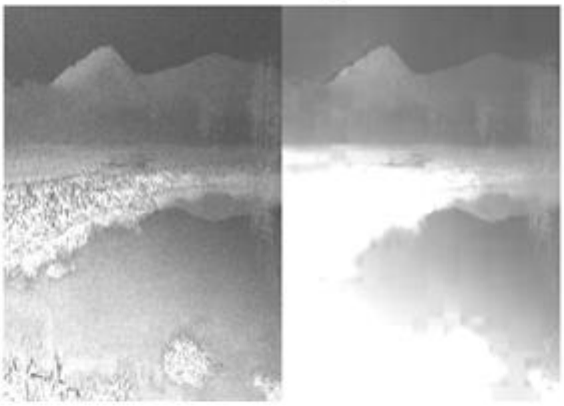
In this section the change of color depth maps technique results are discussed. The execution is carried out using MATLAB 2015a simulated software. The PSNR value of output image is found to be better than the input image.

9.1 Simulation results using mat lab

(a). Input image



(b). Depth maps



(c). Transmission maps

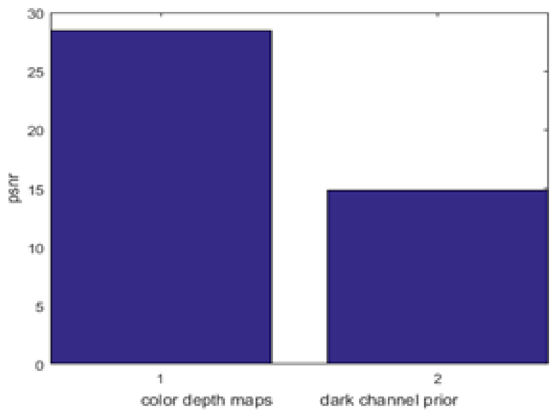
(d). Position of the atmospheric light

(e).foggy image and defogged image

9.2ANALYSIS REPORT

Table 1: Comparative Analysis

Technique	Parameter PSNR
(a) Dark channel prior (existing method)	14.8300
(b) color Depth map (proposed)	28.4863



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10. CONCLUSION AND FUTURE WORK

In this paper, the proposed method a simple but effective prior is called color depth maps technique for single image dehazing. This method is based on the multiple scattering phenomena so the input image becomes blurry. When this method is combined with haze imaging model, single dehazing image becomes simple and effective. This algorithm is based on local content rarer than color and this can be applied to large variety of images. This method is meaningful for color based images for all application. In foggy removal method there is a still common problem is to be solved, that is scattering coefficient β in atmospheric scattering model cannot be regarded as constant in atmospheric conditions. To overcome this problem some more physical models can be taken into account.

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