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Fog Removal From Image Using Contrast and Pixel Orientation with Bilateral filter and Sobel Edge Detection Method

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ABSTRACT

Image processing schemes for removal of haze such as smoke and fog from digital images have been actively researched. In this paper, proposed fog exclusion from image using contrast and pixel orientation with bilateral Sobel and filter edge detection. In the proposed algorithm, because of its velocity and capacity to enhance visibility, may be utilized as a part of numerous frameworks, extending from following and route, surveillance, consumer electronics, keen vehicles to remote detecting .In our proposed outcomes, calculate peak signal noise ratio (PSNR) and mean square error (MSE) for estimating the brightness of a fog free image. We propose the fog removal method which can be functional to not only the usual scene .This strategy can eliminate the impact of haze without relying upon the evaluation of perceivability in light of the fact that the level of mist removal is changed powerfully .

Keywords: Fog removal, Bilateral Filter, Contrast method, Sobel Edge detection,CLAHE,PSNR,MSE

I. INTRODUCTION

The images quality is caused through the state of climate, it will be better when climate is great, while it will be worse when climate is awful. Foggy is a primary awful climate, the image got in foggy climate has low contrast and clarity, and few color knowledge is also lost, which influences the various recognition and analysis. In our nation, foggy is more terrible and more awful with the monetary advancement. Most image recognition schemes are appropriate for ordinary climate, thus the reinstatement of foggy corrupted image to increase the picture quality has great application value. Any image caught in the open atmosphere relies on upon air conditions, if the climate is great image catch is clear and justifiable, if the climate is awful then image quality lessening and articles are not distinguished. One most Universal climate environment is haze that has faint impact on the scene, drop the atmospheric view that origins to the picture contrast refuse and also produces image vagueness. There are visibility records reduced in unpleasant weather condition because of the general incidence of atmospheric components that have big volume and in the contributing medium Distribution. Light reflected through any item is absorbed and scattered with the help of particles exhibits in the climate, causes corruption in the scene visibility . With the quick advancement of computerized image processing technology, system of the video surveillance had been utilized generally. The video images quality is caused through the weather condition, when the climate is good it will be better, otherwise it will be worse when the climate is bad. Foggy is a fundamental bad climate, the image acquired in foggy climate has low determination, clarity and contrast, and data is additionally lost behind that image, which influences the various recognition and analysis. In our nation, foggy is worse and worse with the inancial improvement. Many image recognition schemes are appropriate for normal climate, so the foggy degradation image restoration to improve the picture quality has great application value.

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There are different reasons which impact visibility, including precipitation, mist, fog, dimness, and smoke and in waterfront areas ocean splash, in these conditions light are usually prepared of water beads. The difference between haze, fog, and mist can be measured as the distance visibility. Decrease in view is caused through a scattering and deflection of light through gases and components in the atmosphere. Visibility is typically reduced through spreading particles between image capturing object and device. Components scatter light approaching from the sun and imitated through an object to detain device lens, and the remaining sky throughout the line of sight of viewer, thereby decreasing the contrast between object and background [1].

2. CONTRAST METHOD

Haze diminishes the contrast. Eliminating the enhance haze the image contrast. Contrast maximization [2] is a scheme that increases the contrast under the constraint. But, the resulting images have bigger saturation values because this scheme does not actually advance the depth or brightness but somewhat just visibility enhance. Moreover, the outcome contains halo effects at depth discontinuities.

3. BILATERAL FILTERING

This filtering [3] images smooth's without edges affecting, by nonlinear values of the image. In this filter changes every pixel by weighted averages of its neighbor's pixel. Assigned weight to every neighbor pixel reduces with the distance within image plane and on the intensity axis. This filter helps us to get results faster as compared to other. While applying bilateral filter we use post processing and pre-processing phases forbest results. Histogram equalization is utilized as histogram stretching and pre-processing as a post processing. These both phases help to image contrast increase after and before bilateral filter usage. This algorithm is solidity of fog independent therefore can furthermore be applied to the pictures captured in the fog. It does not need user interference. It has a broad application in navigation and tracking, entertainment industries and consumer electronics.

4. SOBEL EDGE DETECTION

It is applied to achieve the edge detection. This detector uses two masks sizes of 3×3, one detecting the gradient in x-direction and other detecting the gradient in y-direction. The slid mask is over the picture, operating a cube of at time pixels. The algorithm of picture intensity at all points calculates the gradient, and then gives the direction to image intensity increase at all points from light to darkness. Edges regions symbolize powerful intensity contrasts which are brighter or darker [4].

Sobel algorithms work applying a mathematical process known as convolution and usually evaluate second derivatives of digital digits over space.

5. LITERATURE REVIEW

Hiroshiet.al in this paper, they proposed the technique for snowfall degree recognizing automatically, even if most of backgrounds are covered by snow and the visibility of a scene is low through fog. In order to make a foggy image clear in the snowy scene, for this proposed the new fog removal technique which can be applied to not only the typical scene but also the heavy snowy scene.

[5] has observed a new and effective algorithm of the fog removal. The algorithm practices bilateral filter for the estimation of air-light. Through the method of the provide process is free from the concentration of haze and don't involve client obstruction. It can handle both colors as well as gray images.

[6] In this paper, a novel single image haze removal method based on the Fields of Experts model was discussed. Firstly, the coarse atmospheric transmission map isobtained applying the dark channel prior. And then, the Fields of Experts model is adopted to get the priors from the degraded image, so as to amend

the atmosphere transmission map. Finally, the scene albedo is restored based on the atmosphere scattering model. Experiments show that the algorithm can be effective recovery of the image scene information.

[7] In this paper, in order to realize a speed-up of the haze removal method which is based on the min-max bilateral filtering and has been proposed by the authors, it was implemented through applying GPGPU method. Through the experiments,it was confirmed that the speed of the method was severely accelerated sufficient for the practical utilize by using GPGPU technique.

6. PROPOSED WORK

In this study, we worked on two types of images: color image or grayscale image. First of all, in the case of the color image, convert an RGB image into YCbCr format. After that, take a Y component and apply contrast adjustment on this. After that, apply another strategy called blend Contrast Limited Adaptive Histogram Equalization (CLAHE) shading models that precisely created for mist picture improvement. The method operates CLAHE on RGB and YCbCr shading models. The focal target of this technique is to direct noteworthy haze presented by CLAHE keeping in mind the end goal to facilitate a progressive procedure of mist scene pictures. The upgrade technique viably enhances the perceivability of mist scene pictures. Then, apply Bilateral filter for restoring original image. We perform Sobel edge detection on the fog free image. After that, calculate peak signal noise ratio and mean square error.

Proposed Algorithm

1. We take grayscale image or RGB image.
2. If we take an RGB image as an NXN size.
3. Convert RGB into YCbCr format where Y is luminance part (also contain structural information), Cb is Blue Component and Cr is Red Component.
4. Perform contrast adjustment of an image.
5. Let f be a given picture indicate to as a n_r by n_c grid of number pixel intensities running from 0 to L-1. L is the quantity of conceivable force values, regularly 256. Let p show the standardized histogram of f with a container for every possible intensity.

$$P_n = \frac{\text{number of pixels with intensity} n}{\text{total}} \quad n = 0,1...L-1$$

6. The adaptive histogram balanced picture im will be characterized by $im_{ij} = floor\left(L-1\right)\sum_{n=0}^{fi,j} pm$

   where floor() adjusts down to the closest number . This is equivalent to change pixel intensities, k, of f by the capacity

$$T\left(k\right) = floor\ T\left(k\right) = \left(L-1\right)\sum_{n=0}^{k} pn$$

7. The inspiration for this change originates from thinking about the intensities of f nonstop arbitrary variables X,Y on [0,L-1]with Y characterized by

$$Y = T\left(X\right) = \left(L-1\right)\int_0^X px\left(x\right)dx$$

   where pX is the likelihood thickness capacity of f. T is the combined distributive capacity of X reproduced by (L – 1). Accept for effortlessness that T is differentiable and invertible . It can then be demonstrated that Y characterized by T(X) is consistently appropriated on [0, L – 1], namely that pY (y) = 1/L–1 .

8. The bilateral filter outcome for a pixel *s* is then:

$$J_s = \frac{1}{k_s}\sum_{p\in\Omega} f\left(p-s\right)g\left(I_p - I_s\right)I_p$$

Where k(s)) is a normalization term:

$$k_s = \frac{1}{k_s}\sum_{p\in\Omega} f\left(p-s\right)g\left(I_p - I_s\right)$$

In the practice, they utilize Gaussian for *f* in spatial domain, and also Gaussian for the *g* in intensity domain. Therefore, the pixel *s* value is affected mostly through pixel that are close spatially and that has a same intensity. This is the most easy to color images extend, and some metric pixels *g* can be utilized (e.g. CIE-LAB).

9. Then apply Sobel edge detection method for detecting edges and remove shadows from the image.
10. Else, we take grayscale image as an NXN size.
11. Repeat Step3 to Step 9 for grayscale images.
12. Calculate Peak Signal Noise Ratio (PSNR) and Mean Square Error (MSE) between foggy image and fog free image.

$$MSE\left(x\right) = \frac{1}{N}\left\|x - x\wedge\right\|^2 = \frac{1}{N}\sum_{i=1}^{N}\left(x - x\wedge\right)^2$$

Where N is the size of grayscale image or RGB image, x is grayscale image or RGB image and x^ is a fog free grayscale image or RGB image.

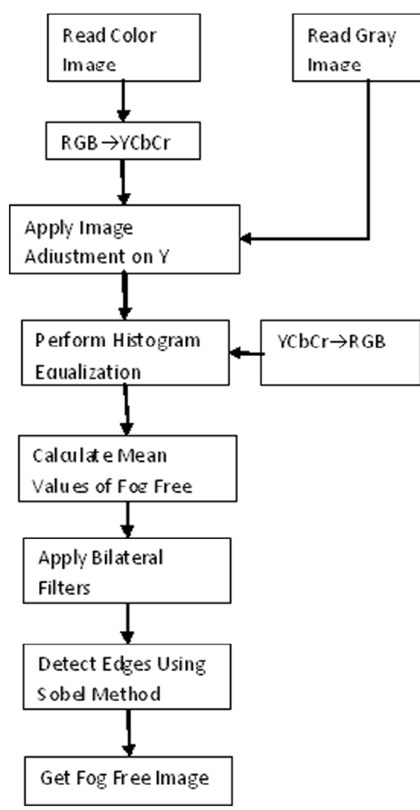


Figure 1: Flow Chart of Proposed Working

7. RESULT ANALYSIS

7.1. Take Image Dataset of Color and Gray Image

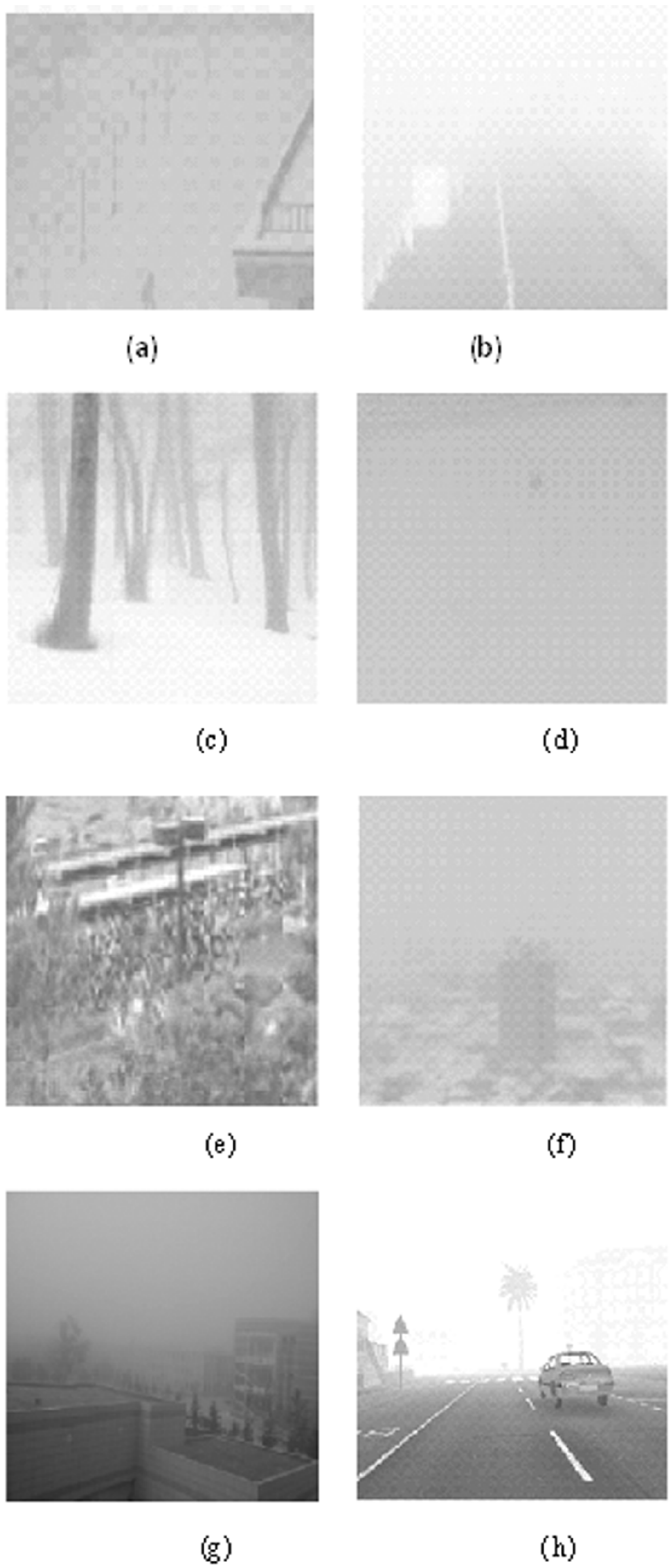
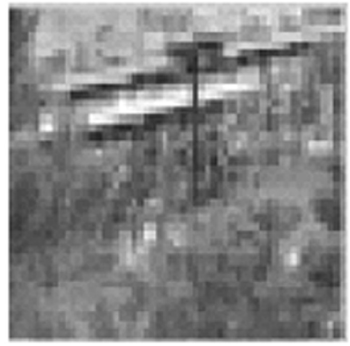


Figure 2: Image Dataset Of Color and Gray Foggy Image

7.2. Proposed Results

(i)



(j)

(k)

(l)

Figure 3: (i) Original Fog Image (j) Hiroshi Kawarabuki Result (k) Our Proposed Fog Free Image (l) Edge Detected Image

(m)

(n)

(p)

(q)

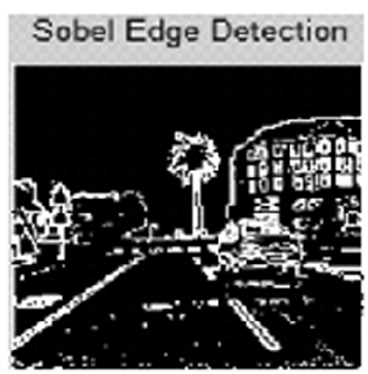
Figure 4: (m) Original Fog Image (n) Hiroshi Kawarabuki Result (p) Our Proposed Fog Free Image (q) Edge Detected Image

(r) (s)

(t) (u)

Figure 5: (r) Original Fog Image (s) Our Proposed Result of First Fog Free Image (t) Our Proposed of Second Fog Free Image u) Edge Detected Image

(v) (w)



(x) (y)

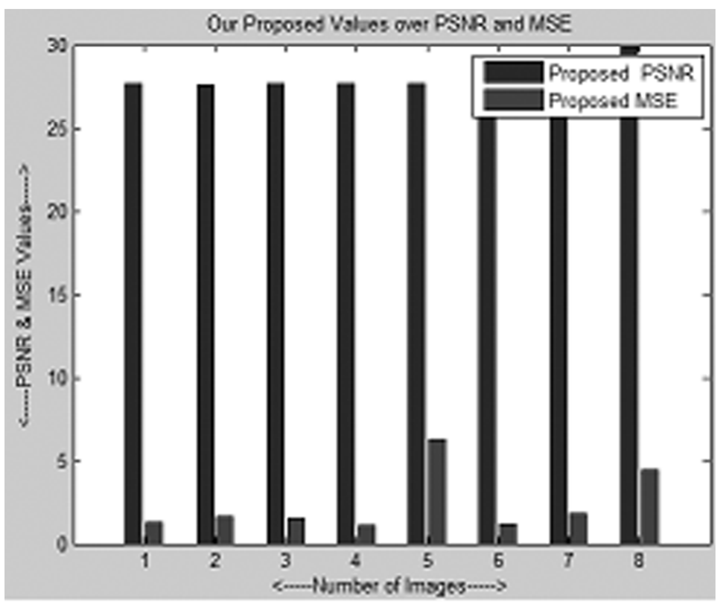
Figure 6: (v) Original Fog Image (w) Our Proposed Result of First Fog Free Image (x) Our Proposed of Second Fog Free Image y) Edge Detected Image

Table 1
PSNR Comparison between Base and Proposed System

Image	*Proposed PSNR*	*Base PSNR*
(a)	55.4126	15.9598
(b)	55.0698	15.5769
(c)	55.2551	24.4845
(d)	55.4126	13.4947
(e)	55.4126	34.1447
(f)	55.0693	24.9351

Table 2
Proposed MSE using Our Method

Image	*Proposed MSE*
(a)	1.2782
(b)	1.6627
(c)	1.5582
(d)	1.0823
(e)	6.3031
(f)	1.1908



Graph 1: Our Proposed Results For Color and Gray Image

4. CONCLUSION

In this paper, proposed a fog exclusion from image using contrast and pixel orientation with bilateral filter and Sobel edge detection.Through the experiments, it was confirmed that the rapidity of the method was drastically accelerated enough for the practical use by using such technique.In the tentative outcomes, we estimate PSNR and MSE value for calculating the brightness intensity of fog free image. In this algorithm, we identify edges of fog free image. Using this experiment, we improve the quality of an imageand get more fog free image. In our proposed, we work on both color or gray images.We will improve it so that the quantity of more detailed snowfall may be obtained in the future, we will extend our work to the problem of outdoors video dehazing.

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