A Robust Image Restoration by Using Dark channel Removal Method

Ankit Jain[1] (MTech. scholar), Prof. Mahima Jain[2]
Department Of Computer Science And Engineering, Bansal Institute of science and technology, Bhopal, 462001, India

Abstract—**This work focus on Fog removal which is also known as visibility restoration refers to different methods that aim to reduce or remove the degradation. The degradation may be due to various factors like relative , relative atmospheric turbulence , object-camera motion, miss-focus , blur due to camera and others. This paper has utilized the dark channel method for estimating the atmospheric light with change in environment. This help in removing the distortion present in the image. Experiment was done on real dataset as well as on artificial dataset images. It has been obtained that that proposed work has improve edge restoration value by 2.4 time, while contrast restoration value was increased by 4.51 time as compare to previous work is better as compare to previous work in [8].**

Index Terms— ***Digital Image Processing, Haze , Information Extraction, Fog removal. Visibility restoration***

I. INTRODUCTION

Nowadays digital cameras are certainly the most used devices to capture images. As cameras are present in very important user electronic device that is mobile phones, palmtop, computer, surveillance system, robot etc. As it can be seen or compare from the previous camera images image quality is increasing day by day with increase in electronic media. This is possible because of the availability of large memory for processing with high speed processor in the same device.

As all kind of images taken from the digital camera have one common transparent medium that is air. As it was assumed that light rays reflect from the objects of the scene and get back to the observer without any changes or alterations. So in this condition light in the image or brightness of the image is dependent on the single point of the scene. So all the algorithms and digital circuit with sensors are designed to work under clear light. So vision system is highly required to work under unclear atmospheric conditions such as fog, rain, snow etc. As ancient painting and painters shows there painting with atmospheric conditions of nature. In their work optical phenomena was present in form of blue haze from different mountains and visibility of the objects got reduced because of bad nature conditions. As Leonardo da Vinci painting contain the atmospheric baground scene with few points are bluer and brighter [10]. As this optical phenomena is an attractive point for the images but in the computer vision system it act as an noise for identifying the objects.

As in order to increase the security of the different important places some of the outdoor surveillance cameras are used for increasing the robustness. But some time due to bad weather condition it is seen that images or video obtain from the camera was not clear and there is no mechanism to improve the visibility through the cameras. /This is because of the drastic change in the contrast and color of the receiving light from the image objects. So by using normal image processing algorithms this images of bad weather condition cannot be improved for getting sufficient information.

Haze removal is a tough task because fog depends on the unknown scene depth information. Fog effect is the function of distance between camera and object. Hence removal of fog requires the estimation of air light map or depth map. The current haze removal method can be divided into two categories: image enhancement and image restoration. Image enhancement does not include the reasons of fog degrading image quality. This method can improve the contrast of haze image but loses some of the information regarding image. Image restoration firstly studies the physical process of image imaging in foggy weather. After observing that degradation model of fog image will be established. At last, the degradation process is inverted to generate the fog free image without the degradation. So, the quality of degraded image could be improved.

II. RELATED WORK

Z. Zhu et. al. [1] introduced an experience fusion method for various images by way of moving objects. The proposed method consist a ghost removal algorithm in a low dynamic series domain and a exposure fusion algorithm. The proposed ghost removal algorithm includes a bidirectional normalization-based method for the finding of non-reliable pixels and a two-round hybrid method for the correction of non-constant pixels. A exposure fusion algorithm consist a content adaptive bilateral filter,that extracts superior details from all the corrected images concurrently in ascent domain. The final image is synthesized by selectively adding the extracted fine details to an in-between image that is generated by fusing all the corrected images via an existing multi-level algorithm.

Canmei Yang et. al. [2] described a novel and efficient single image enhancement algorithm for haze image. As they monitor that, the contrast and intensity of haze image after using dark channel prior approach will necessarily tend to be lower than those of the real scene, they used histogram requirement to make an enhancement on image after dark channel prior approach. They made a large number of experiments and find that, if dealing with a haze image with large background area and low contrast, dark channel prior result will become dark, also a general haze image after dark channel occurs different degree of anamorphous. They introduced an adaptive algorithm to repair the different kinds of an amorphose on the hazy image after dark channel prior.

Khairi Abdulrahim et. al. [3] projected a fast yet tough technique to enhance the visibility of video frames using the dark channel prior united with fuzzy logic-based technique. The dark channel prior is a arithmetical uniformity of outdoor haze-free images based on the examination that most local patches in the haze-free images have pixels which are dark in at least one color channel, where the fuzzy logic-based technique is used to plan an input space to an output space using a collection of fuzzy membership functions and policy to decide delicately in case of doubts. The combination of the dark channel and the fuzzy logic-based technique will make high quality haze-free images in real-time.

Z. Bachok. Et. al. [5] has discussed that the within the last decades, improving the quality of an underwater image has one problem that is poor visibility of the image which is aroused by physical properties of the water medium.

A.C. Bovik et. al. [6] proposed perceptual models that can be able to forecast the value of distorted images with as little prior information of the images or their deformation as possible. The new IQA model, which is known as Natural Image Quality Evaluator is based on the production of a “quality aware” collection of statistical features based on a simple and successful space area natural scene statistic model.

X. Tang et. al. [7] proposed novel widespread guided image filtering method with the suggestion image generated by signal sub-space projection technique. It accepts complicated parallel study through Monte Carlo imitation to choose the dimensions of signal subspace in the patch-based noisy images. The noise free image is reconstructed from the noisy image expected onto the significant images by component analysis. Test images are utilized to decide the relationship between the most favorable parameter value and noise divergence that maximizes the output peak signal-to-noise ratio.

In [8] has presented a new method called mixture CLAHE color models that specifically developed for underwater image enhancement. The process performs CLAHE method on RGB and HSV color models. The projected technique has considerably enhanced the visual superiority of underwater digital images by enhancing illuminate, as well as dropping noise and artifacts.

III. PROPOSED METHODOLOGY

This paper focus on the digital hazy image restoration. Here image store the edge region of the image then apply Laplace distribution for pixel value restoration. Here whole work is explained in fig. 1.

Pre-Processing

Here as the image is the collection of pixels where each pixel is representing a number that is reflecting a number over there now for each number depend on the format it has its range. So read a image means making a matrix of the same dimension of the image then fill the matrix correspond to the pixel value of the image at the cell in the matrix.

Median Filter

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signals, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically.

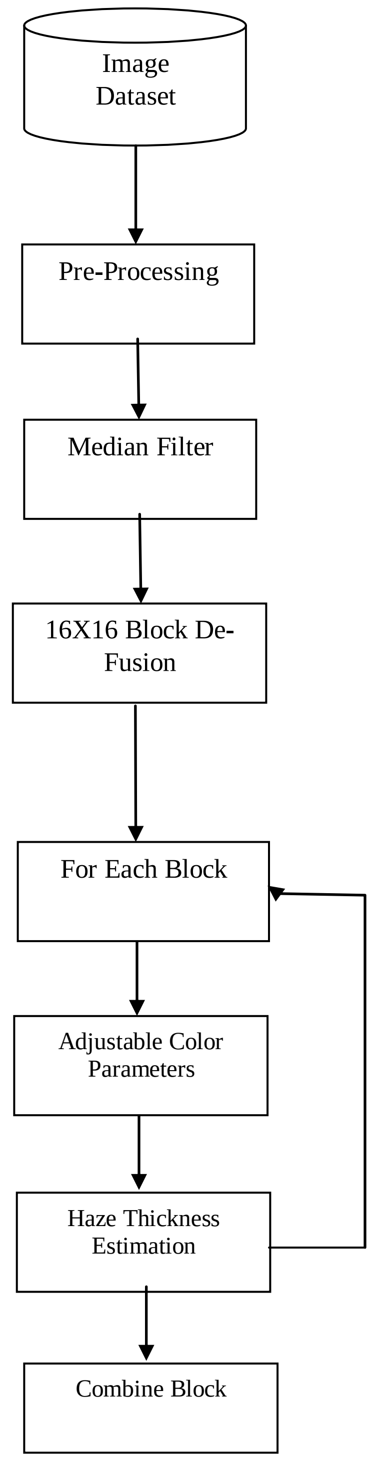

Fig. 1. Block diagram of proposed Re~~storation Image~~ Work.

16X16 Block: As work is done on color image so embedding is done on the red matrix of the image, so whole operation of embedding is done this red matrix. Whole red, green, blue matrix is divide into 16X16 blocks for restoration of image.

Dark channel prior: In [2] Dark channel technique is developed in order to calculate the atmospheric light in the image. So it is emerged as a common technique in non sky part of the image because few color channels has very less intensity in the few pixels. Here in dark color channel low intensity is present because of the below three components:

i). Surface Colourful objects such as grass, trees, etc.

ii). Shadow of tree, building, pillers, etc.

iii). Any high intensity object surface such as black stone, trunk, etc.

So most of outdoor image is full of above three points which include colorful object, few shadows and dark channels which fill image with noise. In presence of fog in environment image get brighter then actual image without fog. So it can be conclude that dark channel of the image have high intensity of image in region with higher haze. So in order to find the light intensity an approx value is find by estimating the thickness of the haze. In case of shady channel prior this technique use pre and post processing steps in order to improve results. In post processing stepladder technique use flexible matting or two-sided filtering etc. This can be understand as if J(x) is input image, I(x) is hazy image, t(x) is the transmission of the environment. The reduction of image because of presence of fog can be calculate by: Here A^c is atmospheric light adjustment parameter in the block so for each block it is evaluate by

$$A^c = \min(\max(S) ----------(1)$$

$$t(x) = \min\left(\frac{I^c}{A^c}\right)-----------(2)$$

In above equation (2) S is the region in the block of image having channel. C represent color band Red, Green, Blue, etc. the effect of fog is Air light effect and it is calculate as:

$$\text{AirLight}(x) = A(1 - t(x))\text{--------------}(3)$$

In this Jc is color image comprising of RGB components, represents a local patch which has its origin at x. The low intensity of dark channels is attributed mainly due to shadows in images, saturated color objects and dark objects in images. After dark channel prior, one need to estimate transmission t(x) for proceeding further with the solution. Another assumption needed is that let Atmospheric light A is also known. This normalize (4) by dividing both sides by A:

$$J^c(x) = \frac{(I^c(x) - A^c(1-t(x)))}{\max(t(x), t_o)} ----(4)$$

Figure 2: Haze removal results. Top: input haze images. Middle: restored haze-free images. Bottom: depth maps.

IV. EXPERIMENT AND RESULT

In this section, first introduce experimental settings, and then present the experimental results that validate the effectiveness of the approach. The experiments actually contain two parts. This work is compare with other previous work in [8] which have utilize the laplace and haze thickness estimation only.

Evaluation Parameters

Visible edge restoration parameter: The *e* metric represents the rate of visible edge restoration in the haze-free image and is given by

$$e = \frac{V_r - V_o}{V_o} - - - (5)$$

where *Vr* and *Vo* represent the total number of visible edges within the restored hazy image and the incoming hazy image, respectively.

Contrast restoration: *r* metric is used to express the quality of contrast restoration within the haze-free image. As such, the *.r* metric is formulated as follows:

$$r = \exp\left[\frac{1}{V_r}\sum_{p_i \in \wp_i} \log(r_i)\right] - - - - (6)$$

where *Pi* is the corresponding element within the set ℘*r*, and *ri* is the rate of gradients between the restored hazy image and the incoming hazy image. Note that ℘*r* consists of the visible edges in the restored hazy image.

Over or Under Exposed Metric: Moreover, the σ metric represents the number of pixels that might be either overexposed as white or underexposed as black in the restored image. The σ metric is calculated as follows:

$$\sigma = \frac{V_s}{\dim_x \dim_y}$$

where *Vs* represents the total of both overexposed and underexposed pixels in the restored image, and dim*x* dim*y* represents the size of the incoming image.

Results

Images		Visible Edge Restoration	
		Proposed Work	Previous Work
1	Fog	1.5841	0.7566
2	Sand	2.7997	1.6057
3	Water	2.2644	-0.3150

Table 1. Comparison of proposed work and previous work on visible edge restoration parameter.

In table 1 It is obtained that proposed work is better as compare to previous as edge restoration value of proposed work is higher as compare to previous. So inclusion of edge feature in haze removal has increase the performance of the work.

Images		Contrast Restoration Image	
		Proposed Work	Previous Work
1	Fog	137.4731	22.6835
2	Sand	123.9415	7.8814
3	Water	291.5944	125.5267

Table 2. Comparison of proposed work and previous work on visible edge restoration parameter.

In table 2 It is obtained that proposed work is better as compare to previous as contrast restoration image value of proposed work is higher as compare to previous. So inclusion of edge feature in haze removal has increase the performance of the work.

Images		Over or Under Exposed Metric	
		Proposed Work	Previous Work
1	Fog	3	0.8734
2	Sand	3	0.5410
3	Water	3	0.6330

Table 3. Comparison of proposed work and previous work on visible edge restoration parameter.

In table 3 It is obtained that proposed work is better as compare to previous as Over or Under Exposed Metric of Restoration image value of proposed work is higher as compare to previous. So inclusion of edge feature in haze removal has increase the performance of the work.

V. CONCLUSIONS

A new combination of median filter with dark channel method is used in this work for dehazing image from different scene. The algorithm removes spatially varying haze based on the haze thickness estimation. As experiment is done on images of different environment and it is obtained that proposed work is better on all the evaluation parameters of de-hazing images. In Future improvements of the method will deal with possible corner, and histogram effects caused by the image processing.

REFERENCES

[1] Z. Li, J. Zheng, And Z. Zhu, "Contenet Adaptive Guided Image Filtering." In Ieee Int. Conf. Multimedia And Expo (Icme), 2014, 2014.

[2] Liu, Feng, And Canmei Yang. "A Fast Method For Single Image Dehazing Using Dark Channel Prior." In Signal Processing, Communications And Computing (Icspcc), 2014 Ieee InternationalConference On, Pp. 483-486. Ieee, 2014.

[3] Alajarmeh, Ahmad, Rosalina Abdul Salam, Mohd Fadzli Marhusin, And Khairi Abdulrahim. "Realtime Video Enhancement For Various Weather Conditions Using Dark Channel And Fuzzy Logic." In Computer And Information Sciences (Iccoins), 2014 International Conference On, Pp. 1-6. Ieee, 2014.

[4] Serikawa, Seiichi, And Huimin Lu. "Underwater Image Dehazing Using Joint Trilateral Filter." Computers & Electrical Engineering 40.1 (2014): 41-50.

[5] Hitam, M. S., W. N. J. H. W. Yussof, E. A. Awalludin, And Z. Bachok. "Mixture Contrast Limited Adaptive Histogram Equalization For Underwater Image Enhancement." In Computer Applications Technology (Iccat), 2013 International Conference On, Pp. 1-5. Ieee, 2013.

[6] A.Mittal, R. Soundararajan, And A.C. Bovik, "Making A Completely Blind Image Quality Analyzer, Ieee Signal Process. Lett., Vol. 20, No.3, Pp.209-212, Mar. 2013.

[7] K. He, J. Sun, And X. Tang, "Guided Image Filtering,"Ieee Trans. Patt. Anal. Mach. Intell., Vol. 35, No. 6, Pp. 1397-1409,2013.

[8] Zhu, Qingsong, Shuai Yang, Pheng Ann Heng, And Xuelong Li. "An Adaptive And Effective Single Image Dehazing Algorithm Based On Dark Channel Prior." Inrobotics And Biomimetics (Robio),2013 Ieee International Conference On, Pp. 1796-1800. Ieee, 2013.

Ankit Jain, MTech. Scholar, Department Of Computer Science And Engineering, Bansal Institute of science and technology, Bhopal, 462001, India

Mahima Jain, Prof. in the Department Of Computer Science And Engineering, Bansal Institute of science and technology, Bhopal, 462001, India