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Real Time Haze Removal using Histogram Processing

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Abstract: ***The haze removal algorithm using dark channel in existing base paper work has been observed to achieve great haze removal effect, but this process is too complex that attributes too much processing time and complexity in the algorithm. The complex algorithm makes its limited applications/uses in real time image processing task. Further, the up sampling and down sampling methods are of simple linear function of pixel intensity and does not preserve the edge contents of the scene. This deteriorates the algorithm performance in terms of entropy of the scene.***

Keywords: PSO, Image Segmentation, Thresholding

1. Introduction

Haze (or fog, mist, and other atmospheric phenomena) is a main degradation of outdoor images, weakening both colors and contrasts. The haze may be due to various factors like relative object camera motion, blur due to camera miss-focus, relative atmospheric violent features and others. In this we will be discussing about the degradations due to bad weather such as fog, haze in an image. The image quality of outdoor scene in the fog and haze weather condition is usually deteriorated by the scattering of a light before reaching the camera due to these large quantities of suspended particles (e.g. fog, haze, smoke, impurities) present in the atmosphere. This occurrence influences the normal work of automatic (mechanized) monitoring system, outdoor recognition system and smart transportation system. Scattering is caused by two basic phenomena such as attenuation and air light.

By the usage of effective haze or fog removal of image, we can improve the stability and robustness of the visual system. Haze removal is a difficult task because fog depends on the unknown scene depth map information. Fog effect is the result of distance between camera and object. Hence removal of fog requires the estimation of air light map or depth map.

The haze removal method can be divided into two categories:

(a) Image enhancement and
(b) Image restoration

These methods can enhance the contrast of haze image but loses some of the information about image. The dark channel prior is a kind of statistics of outdoor haze-free images. It is based on a key observation - most local patches in outdoor haze-free images contain some pixels whose intensity is very low in at least one color channel. Using this prior with the haze imaging model, we can directly estimate the thickness of the haze and recover a high quality haze-free image. Results on a variety of hazy images demonstrate the power of the proposed prior. Moreover, a high quality depth map can also be obtained as a by-product of haze removal.

2. Related Works

In this article we present a new method for seismic image restoration. When observed, a seismic image is the result of an initial deposit system that has been transformed by a set of successive geological deformations (flexures, fault slip, etc) that occurred over a large period of time. [1]

Not only geometric information but also optical information is needed to reproduce ruins using three-dimensional realistic computer graphics as they were when those were founded. [2]

In this paper a new method of Adaptive Genetic Algorithm (AGA) is introduced to optimize the back propagation neural network for Image restoration. [3]

The quality and visual effect of an image is high demanded in avionic embedded field. But the frog and haze is common in the nature environment, so foggy images gathered in bad weather need to be disposed to remove the haze. [4]

In the past two decades, the technique of image processing has made its way into every aspect of today's tech-savvy society. Its applications encompass a wide variety of specialized disciplines including medical imaging, machine vision, remote sensing and astronomy. [5]

Fog is a mixture of two components air, light and direct attenuation, the image quality is reduced and results in large number of problems in video surveillance, tracking and navigation. Thus, to get rid of it in a picture, a lot of defogging methods already been proposed in literature. Defogging can be attained utilizing different images and single image fog removal strategy. This paper presents an overview of the various fog removal techniques. These techniques are widely utilized in outdoor surveillance, object detection, electronic devices etc. The general objective of this paper has been to explore the different methods for efficiently removing the haze from digital images. It has been found that the majority of the existing researchers have neglected many issues like no strategy is perfect for several type of circumstances.[6]

With the pervasive use of handheld digital devices such as camera phones and PDAs, people have started to capture images as a way of recording information. [7]

Detail enhancement is needed by many problems in the field of digital image processing. The available detail enhancement algorithms first divide a source image into a base layer and then into a detail layer via an edge preserving smoothing algorithm, and augment the detail layer to produce a detail enhanced image. [8]

Images of outdoor scenes are usually degraded under bad weather conditions and bad environment which results in a hazy image. The most of haze removal methods based on a single image have ignored the effects of sensor blur and noise. [9]

This paper describes a novel neural network based multiscale image restoration approach. The method uses a Multilayer Perceptron (MLP) trained with synthetic gray level images of artificially degraded co-centered circles. [9]

We present a supervised learning approach for object-category specific restoration, recognition, and segmentation of images which are blurred using an unknown kernel. [10]

3. Algorithm

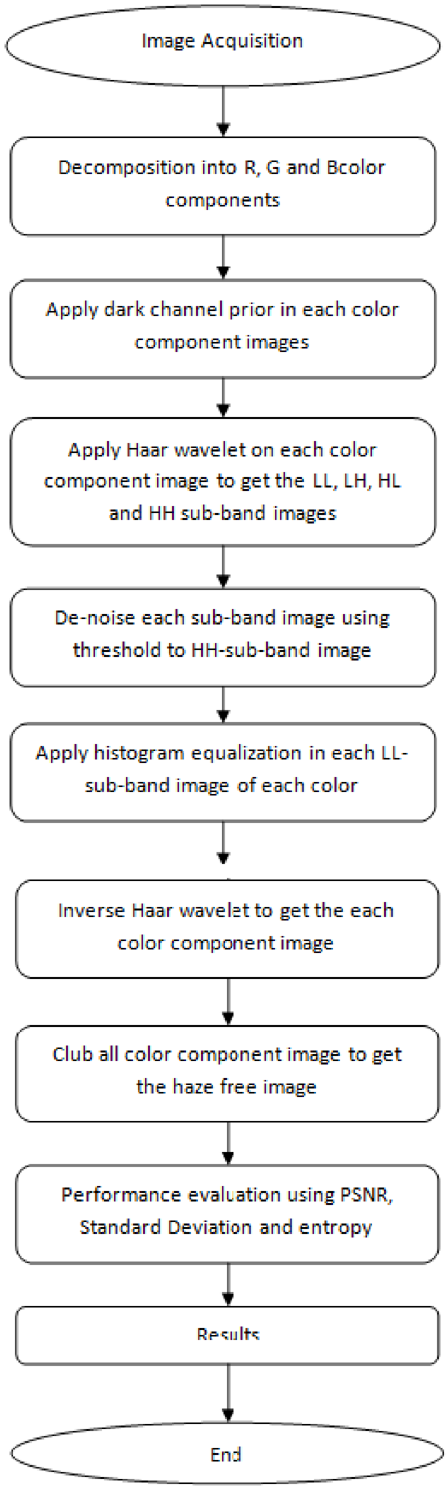
The dark channel prior is a kind of statistics of outdoor haze-free images. It is based on a key observation - most local patches in outdoor haze-free images contain some pixels whose intensity is very low in at least one color channel. Using this prior with the haze imaging model, we can directly estimate the thickness of the haze and recover a high quality haze-free image. Results on a variety of hazy images demonstrate the power of the proposed prior. Moreover, a high quality depth map can also be obtained as a by-product of haze removal.

The proposed work consists of the following steps:

1. Image Acquisition
2. Image decomposition into R-, G- and B-color components
3. Apply dark channel prior in each color component images
4. Apply Haar wavelet on each color component image to get the LL, LH, HL and HH sub-band images
5. De-noise each sub-band image using threshold to HH-sub-band image
6. Apply histogram equalization in each LL-sub-band image of each color component
7. Inverse Haar wavelet to get the each color component image
8. Club all color component image to get the haze free image
9. Performance evaluation using PSNR, Standard Deviation and entropy.

Histogram equalization often produces unrealistic effects in photographs; however it is very useful for scientific images like thermal, satellite or x-ray images, often the same class of images that user would apply false-colour to. Also histogram equalization can produce undesirable effects (like visible image gradient) when applied to images with low colour depth. For example, if applied to 8-bit image displayed with 8-bit gray-scale palette it will further reduce colour depth (number of unique shades of gray) of the image.

Flow Chart



4. Experiments and Results

The algorithm has been implemented on no. of images and following snap shots confirm the efficiency of the proposed algorithm.

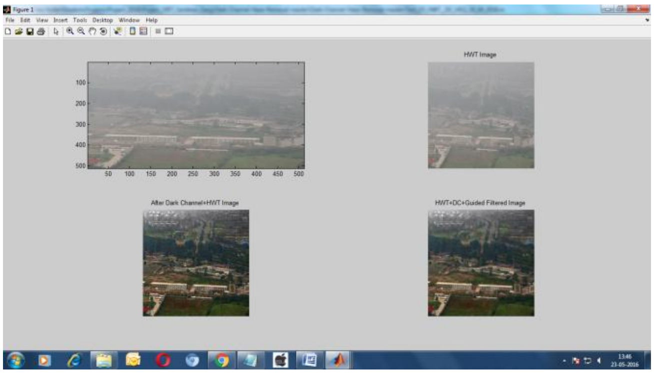


Figure 1:
(a) Hazy Image (b) After Noise Removal
(c) After Dark Channel (d) Final Haze Free Image

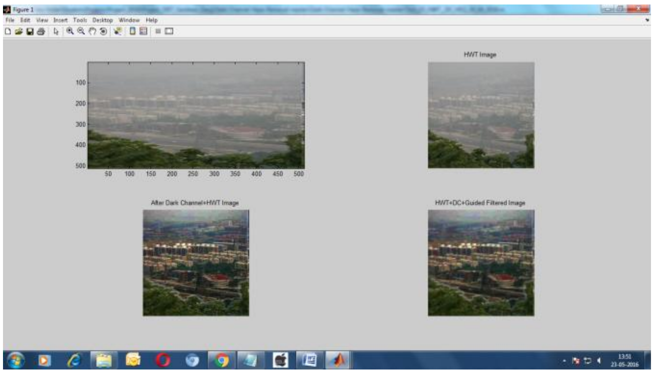


Figure 2:
(a) Hazy Image (b) After Noise Removal
(c) After Dark Channel (d) Final Haze Free Image

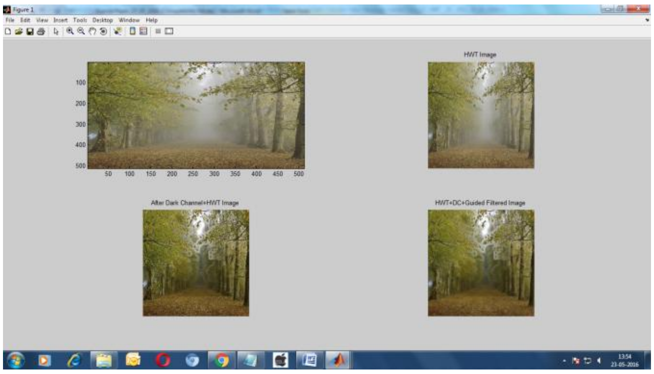


Figure 3:
(a) Hazy Image (b) After Noise Removal (c) After Dark Channel (d) Final Haze Free Image

Table 1: PSNR, SD and Entropy

Fig. No.	*PSNR*	*SD*	*Entropy*
1	67.56	2.099	4.675
2	69.70	3.921	5.543
3	68.76	2.987	5.871

5. Conclusion

The presented work has shown fine improvement over the base paper work in terms of the peak-signal-to-noise ration, standard deviation, variance, time, entropy and mean intensity. The time attribute may further be improved by making the algorithm independent of the image size under test. This will greatly reduce the size burden from the algorithm. The improvements in performance evaluating features may be observed in the result tables. The enhancement in entropy shows the increase in information content in the haze free image over the hazy image. This indicates itself that the haze free image is more informative in terms of its clarity over the hazy image.

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Author's Profile

The author is pursuing her M.Tech. (ECE) thesis work in ECE from DIET, Kharar, Mohali, Punjab INDIA. His field of interest is in DSP based signal conditioning and image processing based applications.