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A Survey on Enhanced Vision of Hazy Images

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Abstract— **: Image processing techniques improve the quality of an image or enhance the maximum information from the degraded image. Image Dehazing is a technique of enhancing the quality of image from given hazy image. It is the process of converting hazy image into a haze free image. Then the resulting image will be more clear and enhanced from the prior. Many development and research is being done in these field areas of Computer Vision, Automatic object detection, Image processing, parallel and distributed processing, Robotics and remote sensing. This thesis reports a detailed study performed over a set of image Dehazing algorithms regarding their implementation. The thesis demonstrates the utility and effectiveness of a dehazing techniques.**

Keywords— **Dehazing,Restoration,DCP,IDCP**

I. INTRODUCTION

Image processing techniques enrich the quality of an image from the degraded image. Image Fusion is a method of improving the quality of image from given input images. The fusion-based strategy derives from two original hazy image inputs through the use of a white balance and a contrast enhancing procedure. Subsequently the resulting image is going to be improved from your past and more obvious. Many development and research is being done in the field areas such as Computer Vision, Automatic object detection, Image processing, parallel and distributed processing, Robotics and remote sensing. This paper reports a comprehensive research performed over some image fusion calculations regarding their execution. The paper illustrates effectiveness and the power of a fusion-based way of dehazing centered on a single degraded image that is changed. The strategy works in a per-pixel manner, which can be straightforward to execute. The dissertation eventually concludes with the evaluation produced about the image fusion calculations that are different, determining the Pyramid Fusion algorithm. Many authors have presented different methods for efficient single image dehazing with goal of improved performance. However each of these existing methods is having their limitations. First, many existing methods use the concept of patches based computation where it is assumed that, in every patch, there is a constant airlight. Generally, the assumptions made by patch-based techniques do not hold. That's why additional post processing steps are required further. Secondly, existing methods use the concept of estimating the depth map which ultimately increases the complexity of dehazing techniques. Due to these limitations most of existing techniques are slower in performance which is not useful techniques under real time environment. Recently one more method based on fusion is presented to overcome above problems successfully; however there are still further needs to investigate this method under different performance parameters and performance conditions.

Visibility restoration [1] refers to different methods that aim to reduce or remove the degradation that have occurred while the digital image was being obtained. The degradation may be due to various factors like relative object-camera motion, blur due to camera misfocus, relative atmospheric turbulence and others. In this we will be discussing about the degradations due to bad weather such as fog, haze, rain and snow in an image. The image quality of outdoor screen in the fog and haze weather condition is usually degraded by the scattering of a light before reaching the camera due to these large quantities of suspended particles (e.g. fog, haze, smoke, impurities) in the atmosphere. This phenomenon affects the normal work of automatic monitoring system, outdoor recognition system and intelligent transportation system. Scattering is caused by two fundamental phenomena such as attenuation and airlight. By the usage of effective haze removal of image we can improve the stability and robustness of the visual system.

II. LITERATURE SURVEY

Defogging can be done by two ways i.e., multiple images fog removal method and single image fog removal method.

Figrue 1. (a) Natural Image

Figure 1.(b) Effect of Attenuation

Multiple images fog removal techniques includes various methods described below:

Vision in bad weather [5] was proposed by S. K. Nayar et. al. In this method multiple images under different weather conditions of the same scene are taken and are then combined to remove haze from image. Later the concept of polarization filters [6-7] was used. These methods used different degree of polarization to remove haze from images.

The above methods have the following drawbacks:

- Multiple images are required to remove fog from image.
- Time complexity of the process is too high.

Thus, single image fog removal methods were proposed, that has much lower time complexity then multiple image haze removal techniques.

Figure 2. (a) Natural Foggy Image

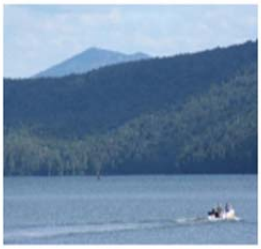


Figure 2. (b) Effect of Air Light

These methods are as follows:

Tae Ho Kil et al. (2013) [6] has proposed the dehazing procedure constructed on dark channel prior and contrast enrichment methods. The orthodox dark channel prior scheme eradicates the haze and thus restores the colors of the objects in the view, but it does not take into account the improvement of image contrast. On the other hand, the image contrast technique increases the local contrast of objects, however the colors are frequently distorted due to the over-stretching of contrast. The projected procedure combines the benefits of the both conventional methods for the possession the color. Aimed at this situation, an optimization function is introduced to keep a balance among the contrast and colors distortion. The proposed methodology adjusts for the drawbacks of conventional methods, and improves the contrast with reduce color alteration.

E. Ullah et al. (2013) [7] evaluated that environmental conditions such as haze, fog or rain noticeably affects the visibility. The water droplets existing in the atmosphere produce mist, fog and haze results due to dispersion of light as it circulates through these particles. These chromatic effects of image dispersion can be reversed for recovery of image knowledge. A single image dehazing technique using dark channel prior has been broaden. The suggested model considers both chromatic and achromatic features of the image to define the Dark Channel. Foremost application regions of real time single image dehazing involve tracking system, consumer electronics and entertainment industry.

Muhammad Suzuri Hitam et.al. (2013) [8] has evaluated a new method called mixture Contrast Limited Adaptive Histogram Equalization (CLAHE) color models that exactly established for underwater image improvement. The technique works CLAHE on RGB and HSV color models and the results are joint together using Euclidean norm. The images considered in this study were taken from Redang Island and Bidong Island in Terengganu, Malaysia. Enhancing the property of an underwater image has received significant attention due to poor visibility of the image which is caused by physical properties of the water medium. The proposed method significantly improves the visual quality of underwater images by enhancing contrast, as well as reducing noise and artifacts.

Abhishek Kumar Tripathi et al. (2012) [5] has examined a novel and effective fog removal algorithm. The algorithm practices bilateral filter for the approximation of air-light. By way of the given process is free from the concentration of fog and don't entail user interference. It can tackle both color as well as gray images. Haze creation is due to attenuation and airlight. Attenuation decreases the contrast and airlight upsurges the paleness in the scene. The procedure has an extensive application in tracking and direction-finding, customer electronics and entertainment. It was observed that, in foggy image estimated air light map depends upon the distance of scene points from camera. Estimated air light map is able to capture the discontinuities across the edges and smooth over the objects.

F-C. Cheng et al. (2012) [10] has discussed that the lowest level channel prior for effective image fog removal. The use of the lowest level channel is simplified from the dark channel prior. It is based on a key observation that fog-free intensity in a color image is usually the minimum value of trichromatic channels. To estimate the transmission model, the dark channel prior then performed as a min filter for the lowest intensity. The the transmission model is recalled to defog an image; then accelerated the refinement of transmission by initiating a fast O (1) bilateral filter based on the raised cosines function to the weight values of neighbors. As compared to the soft matting approach, the suggested strategy results in considerable savings in the cost of transmission refinement.

A.K. Tripathi and S. Mukhopadhyay (2012) [11] have proposed a novel and efficient fog removal algorithm. The fog formation is because of the attenuation and the airlight i.e. the attenuation reduces the contrast and air-light increases the whiteness in the scene. Single image fog removal using anisotropic diffusion uses an anisotropic diffusion to recover a scene contrast. Simulation consequences prove that the algorithm outperforms prior state-of-the-art algorithms in terms of contrast gain, percentage of number of saturated pixels and computation time. The given algorithm is independent of the density of fog and does not require user intervention. It can handle color as well as grey images. Along with the RGB color model, this algorithm can work for HSI model that further reduces the computation.

Yanjuan Shuai et al. (2012) [4] has studied that, with the use of the image haze removal of dark channel prior, one is prone to color distortion phenomenon for some wide white bright part in the image. An image haze removal of wiener filtering based on dark channel prior has been proposed. The given algorithm based on dark channel prior is mainly to evaluate the median function in the usage of the media filtering technique based on the dark channel, as to make the media function more precise and combine. The foggy image reestablishment problem is altered into an optimization problem, and by minimizing the mean-square error a clearer, a fogless image is finally obtained. The proposed algorithm can recapture the contrast of a big white area of foggy image and compensates for the lack of dark channel prior algorithm.

Haoran Xuet et al. (2012) [2] after a profound study on the haze removal technique of single picture over quite a while has actualized a quick haze evacuation algorithm, in light of fast bilateral filtering aggregated with dark colors prior. The calculation begins with the barometric scattering

model, infers an expected transmission map utilizing dark channel prior, and afterward consolidates with gray scale to extract the refined transmission map with the help of fast bilateral filter. It has a quick execution rate and extraordinarily enhances the original algorithm, which is more prolonged. On this groundwork, it has been demonstrated that the why the picture is lower after the haze evacuation utilizing dark channel prior. So another calculation is proposed which has enhanced transmission map recipe. The picture with extensive region of sky typically inclined to distortion when utilizing the dark channel prior, hence a technique of weakening the sky region, intends to enhance the flexibility of the calculation was proposed.

Jiao Long et al. (2012) [11] has introduced a basic however successful technique to uproot haze or fog from a solitary remote sensing picture. This technique is depends upon the dark channel prior and a normal cloudiness imaging model. Remote sensing pictures are broadly utilized within different fields. In any case, they generally experience the ill effects of the awful climate conditions, which likewise influence their sufficient utilization. A low-pass Gaussian channel is used to refine the coarse evaluated atmospheric veil. However this methodology attains great effects with almost no transforming time.

Kaiming He et al. (2011) [12] has concluded that the dark channel prior is a sort of statistics of outdoor haze-free images. It is dependent upon a key perception that the most nearby patches in outdoor haze-free images encompass some pixels whose strength is very low in at least one color channel. Utilizing this with the cloudiness imaging model, one can specifically assess the thickness of the fog and recover an amazing haze free picture. Additionally, a high quality map can likewise be gotten as a side effect of cloudiness evacuation. Therefore, these dark pixels can straight forwardly give a precise estimation of the fog transmission. Joining a haze imaging model and a delicate matting interpolation system, an excellent fog free picture can be recovered.

Dark Channel Prior Technique (DCP):

This method [21] estimates transmission map [13], [20] and air-light to recover original one from foggy image. To estimates the transmission map [22], it uses the lowest intensity pixel of image in 3 color planes in patch size of different variations, after which soft matting [19] and bilateral filter [26] operation are performed to get final defogged image.

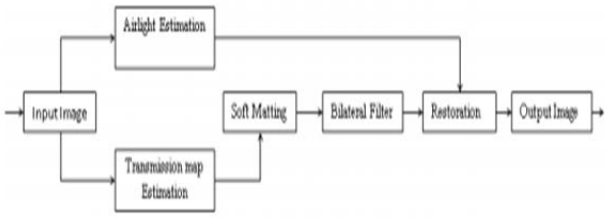


Figure 3. Block Diagram of DCP Algorithm

Improved Single Image Dehazing using Dark Channel Prior:

In this proposal [23], a novel estimation of atmospheric light has been proposed. Compared to the Dark Channel Prior method, it can obtain better results and also resolves that the substantial sky region of recovered image usually tends to be distorted.

Figure 4. Block Diagram of IDCP Algorithm

Improved Haze Removal Algorithm using Dark Channel Prior (based on Guided Filter):

Dark Channel Prior may not work on particular images, especially where the large grey region is similar to the global atmospheric light. In this approach [24], atmospheric light is estimated, based on the imaging law of very dense hazy regions more accurately. Also, a replacement mechanism is designed for optimizing the rough transmission map, it wouldn't process on that area where it don't require.

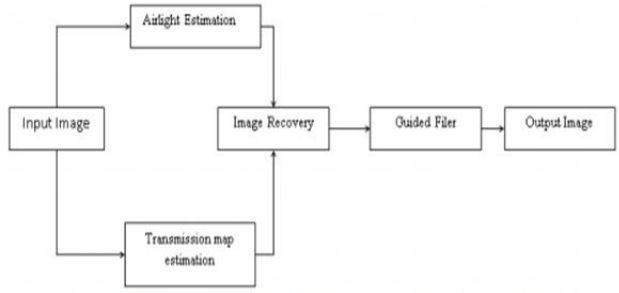
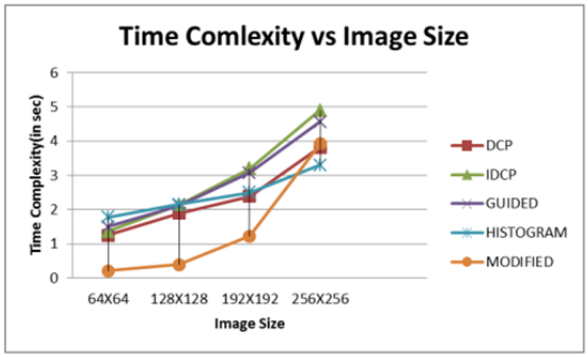


Figure 5. Block Diagram of IDCP Algorithm using GUIDED FILTER

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

Improved DCP with histogram specification [25] has been proposed to improve the contrast of the recovered image which involves rebuilding the histogram of image with following advantages. 1. Firstly, prevents reduction of the image contrast. 2. Secondly, DCP method don't underestimates the attenuation of the foreground irradiance though haze. 3. Thirdly, if the haze image has large background area or low contrast then also it prevents from merges the scene with the thick haze. Due to the above advantages, Improved DCP with histogram specification has been proposed to improve the contrast of the recovered image which involves rebuilding the histogram of image. Disadvantage: If the haze in the image is not removed clearly, this method will increase the thickness of the haze.

Comparison of various Algorithms



Parameter	DCP	Improved DCP	Guided Filter	Histogram Specification	Modified
TIME	VERY HIGH	HIGH	LOW	LOW	VERY LOW
HALO EFFECT	VERY HIGH	MEDIUM	LOW	HIGH	VERY LOW
EDGE PRESERVATION	VERY LOW	LOW	MEDIUM	HIGH	VERY HIGH

III. Conclusions

In this paper we review the different algorithms for dehazing the haze and foggy images. This review work to minimize artifacts introduced by the weight maps, multi-scale fashion, and Laplacian pyramid representation method performs in a per-pixel fashion. We discuss a variety of image fusion techniques, grey scale level, pyramid approaches, rgb colour approaches. From this survey, a number of shortcomings and limitations were highlighted in each and every technique. This paper contains an abstract view of various techniques proposed in recent past year for single image dehazing.

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