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REVIEW ARTICLE

A Review on Image Dehazing Methods

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Abstract - This review paper presents a study about various image dehazing methods to remove the haze in the captured hazy images to recover a better and improved quality of haze free images. One of the critical problems in the field of image processing is the restoration of the images those are corrupted due to various degradations. Images of natural outdoor scenes is degraded due to bad weather conditions such as fog, haze etc. Due to the presence of these atmospheric particles there is a resultant decay in the colour and contrast of the captured image in the bad weather conditions. This may cause difficulty in detecting the objects in the captured hazy images or scenes. Now -a- days due to the recent development of the computer vision area, it is possible to improve the outdoor hazy images and remove the haze from the images.

Keyword-Dehazing; Airlight; ICA; Polarization; Dark channel prior; Choromaticity

A. Introduction

Images of natural scenes is degraded due to bad weather such as fog, smoke etc. The natural phenomena such as fog, smoke are occurs mainly due to atmospheric absorption and scattering. While taking the image during bad weather condition ,the radiance flux(irradiance)received by the camera from the scene point is attenuated along the line of sight. The incoming light is mixed with the light coming from all other directions called the airlight. In this phenomenon, the amount of scattering depends upon the distance of the scene points from the camera. Due to this the there is significant decay in the colour and the contrast of the captured image.

Fog removal is basic requirement in the field of computer vision applications and in the navigational applications. Removal of fog from the input foggy image can exponentially increase the visibility of the scene. Recently, many computer vision algorithms suffer from low- contrast scene radiance. Many of the automatic systems such as surveillance, intelligent vehicles, outdoor object recognition, etc., we assume that the input images have clear visibility. But it is not applicable in many of the real world situations. Fog removal is one of the major problem in the field of image processing , because the fog is purely dependent upon unknown depth. For a single input foggy image the fog removal problem is under constrained problem. Therefore many researchers follow a new strategy , which is based on multiple images of the same scene .

B. Dehazing Methods

During bad weather conditions the atmosphere contains the fog and smoke particles. Due to this, it can significantly reduce the color and contrast of the images. In this phenomenon the amount of degradation increases with the distance from the camera to the object. The removal of fog from the captured foggy images is required to estimate the depth of the fog. The initial works for the fog removal uses multiple input images of the same scene that has been taken during different bad weather condition and the recent fog removal method requires only single input image for the estimation of the depth.

Schechner and et al [1] method is based on the fact that airlight scattered by the atmospheric particles is always partially polarized. In this approach, the polarization filter alone cannot remove the fog effects from images. Here image formation is mainly occurs due to the polarization effect of atmospheric scattering and then inverting this process is required to obtain fog free image. In this method, input image is basically composed of mainly two unknown components. The first one is the scene radiance in the absence of the fog and the other one is airlight. In order to recover these two unknowns, we need two independent images. It can easily be obtained, because the airlight is usually partially polarized. This method that doesn't need the weather conditions to change and it can be applied at any time.

Tan [2] method is based on single image dehazing. This method based on the optical model. The optical model consists of two terms. The first term is the direct attenuation and the second term is the airlight. He then expressed it in terms of light chromaticity and as color vector components. This proposed approach is based on the assumption that the clear day images has high contrast as compared to the images those are affected by the bad weather. Relying upon this assumption, Tan removed the haze by maximizing the local contrast of the restored image.

Fattal[3] proposed a method which is based upon the independent component analysis (ICA). This method describes about the optical transmission in foggy images. Recently, he introduced a new method for single image dehazing which produced a fog free image from the input foggy image. Fattal described about the refined image formation model that consists of mainly two terms. The first one is surface shading and the other one is transmission function. Fattal grouped this pixel belonging to the same surface having the same reflection factor and the same constant surface albedo. Recently he introduced new method which is based upon ICA(Independent Component Analysis) in order to determine the surface shading and the transmission. The aim is to resolve the airlight albedo ambiguity while assuming that the surface shading and the scene transmission are unrelated. Based upon this assumption, scattered light is removed in order to increase scene visibility and remove fog in order to increase scene contrasts of the images. Here restoration is mainly based upon the colour information. This method is not applicable for the gray scale image and also for dense fog.

He and et al [4] method is based upon dark channel prior which is basically used for single image dehazing method. This dark channel prior is mainly used to measure the statistics of the outdoor fog free image. This method is based on the assumption that some pixels are having very low intensity in any one of the colour channel in the case of regions which do not cover the sky. These pixels are known as the dark pixels. In the case of foggy images, the intensity of the dark pixels is mainly contributed by the airlight. These dark pixels are used to estimate the fog transmission. The aim of this technique is to restore fog free image from the transmission map.

Kopf et al[5] method is based on the three dimensional model of the outdoor image or scene. This method does not require multiple images of same scene taken through different degree of polarization. The main difficulty with this method is the structure of the real world are significantly varied. This approach is purely dependent upon application. It requires the interactions with an expert.

Tarel et al[6] method based upon fast visibility restoration algorithm. We can take airlight as a percentage between local standard deviation and local mean of the whiteness. In this method depth map can be used to smooth along the corners. This method depend upon linear operations. It requires many parameters for the adjustment.

Fang et al [7] proposed a method based on the graph based segmentation. Here graph based image segmentation is applied to segment the foggy image. Then initial transmission map is obtained according to the blackbody theory. After that, a bilateral filter is used to refine the transmission map. In this foggy image choice of segmentation control parameters is difficult.

C. Conclusion

In this paper we have described that the haze layer present in the captured input image is dependent on the scene depth and it is variant in nature. Also in this paper we have addressed different method in which the haze can be estimated from the captured hazy images and after estimating the depth map and using the image formation model a better and improved haze free image can be recovered.

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