I J C T A, 9(34) 2016, pp. 77-82

A Study on Different Pre-processing Techniques for Foggy or Hazy Image Filtration

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ABSTRACT

This paper presents a study on different pre-processing Techniques for foggy or hazy image filtration. Haze or fog creates serious problem in graphics or computer vision applications as it affects the visibility of the scene very badly. Two main components exist in images as part of fog and they are attenuation and air light. *Attenuation* is a general term that refers to any reduction in the strength of a signal or it is the gradual loss in intensity. It also increases the whiteness of the scene. Many applications like object detection, surveillance etc can be used as filtration techniques to remove fog from these images. The objective of this paper is to describe various pre-processing techniques to filter the haze from the acquired hazy images and to recover a better and improved quality of haze or fog free images.

Keywords: Air light, Attenuation, Dehazing, Polarizers, ICA, Depth, Fattal Method, Anisotropic Diffusion, Bayesian, DCP.

1. INTRODUCTION

Quality assurance of an image is very important in the area of image mining and processing. Bad weather conditions diminish the quality of the images of outdoor scenes. When photographs are considered it is a serious issue as it changes the colours and reduces contrast of daily taken photos. It diminishes the clearance of the scenes and causes serious harm to applications like outdoor surveillance system, object detection etc and it also decreases the clarity of satellite as well as underwater images. So filtering fog from images is a widely demanded area in computer graphics and computer vision related systems. Image pre-processing can significantly increase the reliability of an optical inspection. Several filter operations which reduce certain image details enable an easier or faster evaluation and as a result of that users are able to optimize a camera image with just a few clicks. Images of outdoor scenes are generally degraded by the presence of different atmospheric droplets like haze, fog, smoke etc. These are all the results of phenomenon's like atmospheric absorption and scattering. While acquiring a scene in the camera in a bad weather condition the the difficulty in radiance received by the camera from the scene point is attenuated along the line of sight. The incoming light flux is combined with the light from all other directions called the airlight. The strength of scattering depends on the distance of the scene points from the camera and the degradation seems to be changing. Due to this there is a reduction in the colour and the contrast of the acquired degraded image. So in order to filter this hazy or foggy image several pre-processing techniques are used like polarization, independent component analysis, dark channel prior etc.

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2. LITERATURE SURVEY

Haze filtration methods can be classified into two types. They are multiple image dehazing method and single image dehazing.

2.1. Multiple Image Dehazing Method

In this dehazing, two or more images or multiple images of the same scene are taken.This technique attains known variables and neglects the unknown variables. The methods comes under this category are depth map method, weather condition method, polarization based method etc and they are explained below.

2.1.1. Depth Map Based Method

Depth information is taken in this method where it uses a single image. Here there is a belief that the 3D geometric model [6] of the scene is given by some databases such as Google maps and it also makes an assumption on the texture of the scene. We get the scene depth information by making a combination of the 3D model with the foggy image. When user interference is also provided it gives more accurate results. The main demerit of this method is that it is not automatic and needs an estimation of more accurate parameters.

Hazy Image

Hazy Free Image

2.1.2. Weather Condition Based Method

This method has multiple images taken from different weathered conditions. Then it takes the differences of two or more images of similar scenes. This technique improves its ability to improve the contrast, but it has to wait until the variation in the properties of the medium. So, the main demerit of this approach is that it is unable to deliver the results instantly for scenes that have never been met before and also unable to handle dynamic scenes.

Hazy Image

Clear Weather Image

2.1.3. Polarization Based Method

Polarization based filtering approach is proposed by Yoav[4], says that polarization filter alone cant remove the fog effect in the images. Generally image formation is the result of atmospheric scattering and an inverted image is needed to get a fog free image. The image is consists of two main unknown components, first is the scene component in the absence of haze and the other one is the airlight which is half polarized. In this method there is no need to process images taken in different weathered situations and it can be applied instantly. The images are captured through a polarizer and it undergoes polarization filtering. It will improve the contrast of the single input image. Polarization filtering is used for finding the haze content of the image and then this haze contents are eliminated from the image to get the clear non hazy image.

Hazy Image

Hazy Free Image

2.2. Single Image Dehazing Method

This method requires a single input image and it depends upon assumptions and it also reclaim the scene data based on last data from single image. This method is now attracting many researchers and the different methods which comes under this category are as follows

2.2.1. Dark Channel Prior (DCP)

Single image dehazing is mainly based on prior assumptions and it is also based on the statistic approach [9] of the outdoor fog free image. Some pixels have very low intensity values in at least one colour (RGB) channel, mostly in local regions which do not cover the sky and these pixels are called as dark pixels. These pixels give the estimation of haze transmission and it gives more accurate results. The main demerit of this method is that it is not automatic and it needs further estimation of parameters.

Hazy Image

Hazy Free Image

2.2.2. Fattal Method

In this technique[5] Fattal assumes that the signals for shading and transmission are un-correlated and by using this the airlight-albedo ambiguity can be resolved. An independent component analysis method is used for transmission. Then the colour of the whole image is reduced by Markov random field. This technique is well suited for removing haze and for restoring the contrasts of complex scene but it does not work well for hazy image. Here pixels having the same constant surface albedo are grouped. The main demerit of this method is that it does not work well for dense hazy image.

Hazy Image

Haze Free Image

2.2.3. Tan's Method

This method [8] proposes a computerized system for dehazing and it is based on two main assumptions. The first assumption is that the images with enhanced visibility have more contrast values than images produced in bad weather. The second assumption is that air light whose variation proportional to the separation of objects to the viewer has a tendency to be smooth. Tan designed the model based on these two assumptions and the results produced have high immersion values and radiances at depth discontinuities.

Hazy Image

Restored Image

2.2.4. Anisotropic Diffusion

Anisotrophic diffusion[10] is a very effective haze removal algorithm. Here haze happens mainly due to attenuation and air light. This method is independent of fog density and does not require user intervention and it works well for HSI (hue, saturation and intensity) model. One of the main demerit of this method is

that haze can be removed without removing parts such as edges, lines etc which are necessary for the understanding of the image. Another advantage is that computation is very decreased in this method and it has a wide application in tracking, navigation, industries etc. This method produces accurate results and does well in situations of heavy haze.

Hazy Image

Haze Free Image

2.2.5. Histogram Equalisation

Image histogram[13] is used in this method to improve the contrast. Contrast can be improved by rebuilding the histogram of the image. This histogram prevents reduction of the image contrast.

Hazy Image

Haze Free Image

2.2.6. Bayesian Probabilistic Model

In Bayesian Probabilistic model[15] image is modelled with the help of factorial markov random field (FMRF),which includes two main statistically independent component like scene depth and albedo. A combined estimation method is used to factorize a single image into its scene depth and albedo.

3. CONCLUSION

Haze removal algorithms are more useful for remote sensing, navigation, object detection, satellite image identification, and many vision applications. This survey presents some effective defogging methods to produce complete speckle free images. All these existing methods can be modified with the help of some other algorithms so that better results can be obtained.

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