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A Survey on Haze Removal using Image Visibility Restoration Technique

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Abstract- Images captured during adverse weather conditions frequently feature degraded visibility and undesirable color cast effects. Images captured in foggy weather conditions often suffer from poor visibility, which will create a lot of impacts on the outdoor computer vision systems, such as video surveillance, intelligent transportation assistance system, and remote sensing space cameras and so on. One of the central problems in image processing in open-air is the presence of cloud, fog or smoke which fades the colors and reduces the contrast of the observed things. Images of outdoor scenes captured during inclement weather conditions. Image processing techniques improve the quality of an image and enhance the maximum information from the degraded image. In this paper, we propose a effective Dark Channel Prior technique, which is apply on selected region to estimate the atmospheric light, and obtain more accurate result. The Dark Channel Prior is a kind of statistics of the haze-free outdoor image. And thus it obtains a high-quality haze-free image using Image processing approach.

Keywords- "Single Image Dehazing", "Visibility Improvement", "Dark Channel Prior", "Transmission map".

I. INTRODUCTION

Outdoor scene images captured in the bad weather are often degraded due to the existence of the haze, fog, mist, or other media. The main cause of image degradation is due to bad weather conditions such as fog, haze, rain and snow. During Fog, when we take an image using a camera then the light gets scattered before reaching the camera due to some impurities in the atmosphere. Due to this, automatic monitoring system, outdoor recognition system and intelligent transportation system are badly affected. Scattering of light is caused by two fundamental phenomena such as attenuation and airlight. By using haze removal algorithms, we can enhance the stability and robustness of the visual system. Removal of haze is a difficult task because fog depends upon the unknown scene depth information. Fog effect is defined as event of distance between camera and object. The haze removal techniques can be classified into two categories: image enhancement and image restoration. Image enhancement doesn't include the reason why fog degrades image quality. This technique enhances the contrast of haze image but it leads to loss of information in image. Image restoration studies the physical procedure of imaging in fog. After observing degradation style of fog and haze, image will undoubtedly be established. At last, the degradation process is used to produce the fog free image.

Related to image visibility degradation can be problematic to many systems which operate under a wide range of weather conditions, including outdoor object recognition systems, remote sensing systems, intelligent transportation systems such as travelling vehicle data recorders and traffic surveillance systems. Haze is produced by the presence of suspended little particles in the atmosphere, called aerosols, which are able to absorb and scatter the light beams. Recently, image dehazing has become an important and urgent research problem in the field of computer vision. The processing of the image which is foggy or full of haze is quite difficult. Unfortunately, the nature of fog or haze is unpredictable i.e., the haze effects vary across the scene. It simply means to say that the modelling the real fog or haze model is not always appropriate. Early researchers use the traditional techniques of image processing to remove the haze from a single image. However, the dehazing effect is limited, because a single hazy image can hardly provide much information. Later, researchers try to improve the dehazing performance with multiple images. Narasimhan et al. propose haze removal approaches with multiple images of the same scene under different weather conditions. Tan's work, is based on two observations. One is that haze-free images have more contrast than images degraded by bad weather; the other is that the variations of airlight, which mainly depends on the distance of objects to the viewer, tend to be smooth. Recently, many studies have focused on single image approaches to restore the visibility of a hazy image. These approaches are based on either strong assumptions or robust priors, by which haze thickness is estimated by using only a single image. A haze-free image possesses evident contrasts compared with a hazy image. By using observations of scene contrast changes, the method restores the visibility of an image by maximizing its local contrast.

II. LITERATURE REVIEW

In order to improve visibility in hazy images, early researchers use the traditional techniques of image processing to remove the haze from a single image.

Shih-Chia Huang et al in [1], presented Images captured during fog conditions often feature corrupted visibility and undesirable color cast property. In this method, visibility restoration approaches usually cannot sufficiently restore images due to reduced evaluation of fog depth and the perseverance of color cast problems. The author presented a visibility restoration approach using Laplacian-method to remove fog thickness estimation and color cast problems. So, a better image with clear visibility and colorful image can be generated.

Qingsong Zhu et al in [2], proposed a novel and effective single image improvement algorithm for fog image. The author introduced a new algorithm to refine the different kinds of an amorphous on the foggy image after apply dark channel prior. The results showed that this method makes the dehazing result more close to actual scene.

Xiangdong Zhang et al in [3], proposed a general method for image contrast improvement and noise reduction. The procedure is developed mainly for enhancing images acquired under extremely low light situation where the features of images are nearly unseen. After using better and effective image de-fog algorithm to the inverted input image, the contrast get improved and the dark surface become bright when the intensity can be amplified.

K. He, J. Sun, Wang Bo [5], proposed a simple but efficient iterative method for recovering fog-free scene contrast and increasing scene visibility from an isolated foggy image. The key benefit of projected algorithm compare with others is its speed and effectiveness for both gray level and color images. A comparative study with other state-of-art algorithms is proposed to demonstrate that parallel or better quality outcome of his scheme are obtained with just little fraction time utilization.

III. PROPOSED WORK

In this work we have proposed a approach that will effectively solve inadequate haze thickness estimation and color cast problems. By doing so, a high quality image with clear visibility and vivid color can be generated. The proposed method can dramatically improve images captured during inclement weather conditions and produce results superior to those of other state-of-the-art methods.

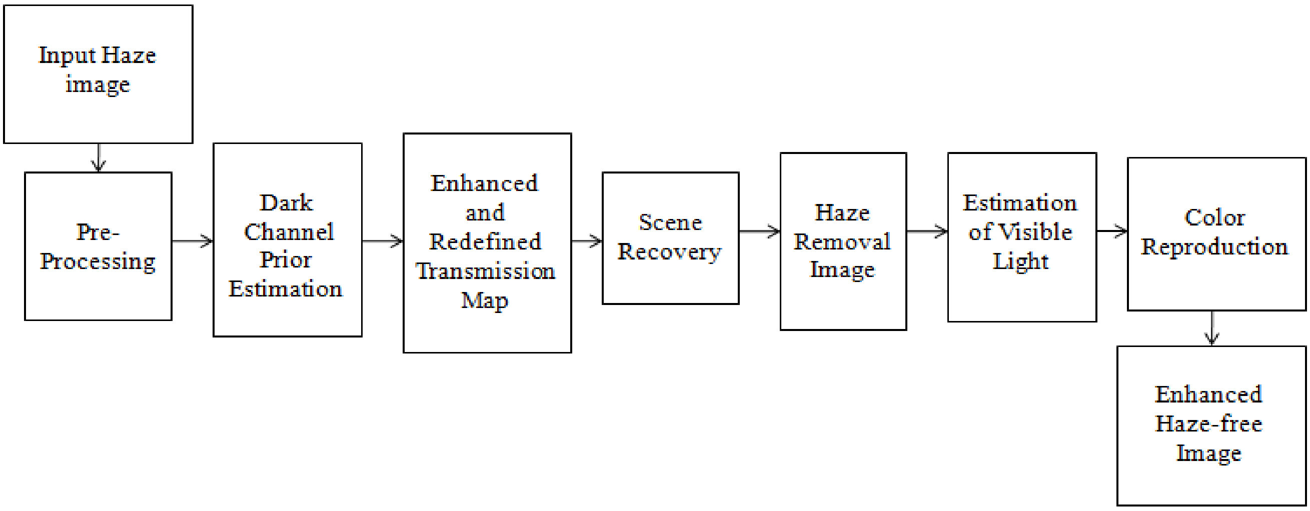

Fig No: 1 Proposed Technique

In this work we first remove haze from image, and then improve the quality of image and restored the visibility of original image and thus obtain a high-quality haze-free image using Image processing approach. The experimental results demonstrate that the proposed technique produces a satisfactory restored image. By using haze removal algorithms, we can enhance the stability and robustness of the visual system. The haze removal techniques can be classified into two categories: image enhancement and image restoration. Image enhancement doesn't include the reason why fog degrades image quality. This technique enhances the contrast of haze image but it leads to loss of information in image. In this work, we introduce an improved single image de hazing algorithm, which is based Dark channel prior Estimation on selected region to estimate the atmospheric light, and obtain more accurate result. Here, It describes the formation of a haze image as follows:

$$I(x) = J(x)t(x) + A(1 - t(x)) \quad \text{.................(1)}$$

Where I is the observed haze image, J is the scene radiance, A is the global atmospheric light, and t is the medium transmission. It describes the portion of the light that is not scattered and reaches the camera. The goal of haze removal is to recover J, A, and t from I.

The haze removal is under-constrained if the input is only a single haze image. So a correct assumptions need to be made in order to obtain good results. Now, we first introduce a simple and elegant dark channel prior.

Pre-Processing: In our scheme, we first upload hazy image then goes towards the further processing. As a pre-processing step is especially convenient considering that it is already necessary for estimating the atmospheric light and transmission map.

Dark Channel Prior Estimation: we propose a Dark Channel Prior, for single image haze removal. Dark channel prior method can produce a natural haze free image. However, because this approach is based on a statistically independent assumption in a local patch, it requires the independent components varying significantly. The dark channel prior is based on the following observation on haze free outdoor images: in most of the non-sky patches, at least one color channel has very low intensity at some pixels. In other words, the minimum intensity in such a patch should have a very low value. Formally, for an image J, we define:

$$J^{dark}(x) = \min_{c\in\{r,g,b\}} \left(\min_{y\in\Omega(x)} (J^c(y)) \right) \quad \text{.....................(2)}$$

Where J' is a color channel of J and Q(x) is a local patch centered at x. Our observation says that except for the sky region, the intensity of Jdark is low and tends to be zero, if J is a haze-free outdoor image. We call Jdmk the dark channel of J, and we call the above statistical observation or knowledge the dark channel prior. The low intensities in the dark channel are mainly due to three factors: a) Shadows. e.g., the shadows of cars, the shadows of leaves, b) Colorful objects or surfaces. e.g., any object (for example, green grass/tree/plant, blue water surface; b); c) Dark objects or surfaces. e.g., dark tree trunk and stone.

Estimating the Atmospheric Light: The atmospheric light was estimated from haze image by using dark channel prior with a fixed patch size. This method is efficient in a variety of images. But in some special images, for example images with multiple light sources, the estimation will be invalid. If the min filtering is done with a too small window, then it may pick up light sources in the image, which can corrupt the estimation The red pixels show the group of pixels the algorithm finds the max R, G, and B values amongst to assemble the atmospheric light estimate.

Estimating the Transmission: In Enhanced and Redefined Transmission Map, this step estimates the transmission in following way, here assume that the transmission in a local patch Q(x) is constant. We denote the patch's transmission as l(x). Taking the min operation in the local patch on the haze imaging Equation (1), we have:

$$\min_{y\in\Omega(x)} (I^c(y)) = t(x) \min_{y\in\Omega(x)} (J^c(y)) + (1 - t(x))A^c \quad \text{..................(3)}$$

Notice that the min operation is performed on three color channels independently. The estimated transmission map from an input haze image is roughly good. But it contains some block effects since the transmission is not always constant in a patch.

Scene Recovery: With the transmission map, we can recover the scene radiance according to Equation (1). But the direct attenuation term **J**(**x**) *t*(**x**) can be very close to zero when the transmission *t*(**x**) is close to zero. The directly recovered scene radiance **J** is prone to noise. Therefore, we restrict the transmission *t*(**x**) to a lower bound *t*0, which means that a small amount of haze are preserved in very dense haze regions.

The final scene radiance **J**(**x**) is recovered by:

$$\mathbf{J}(\mathbf{x}) = \frac{\mathbf{I}(\mathbf{x}) - \mathbf{A}}{\max(t(\mathbf{x}), t_0)} + \mathbf{A}. \qquad \text{.......................(4)}$$

A typical value of $t0$ is 0.1.Since the scene radiance is usually not as bright as the atmospheric light, the image after haze removal looks dim. So, we increase the exposure of **J**(**x**) for display.

IV. CONCLUSION

Haze due to dust, smoke and other dry particles reduces visibility for distant regions by causing a distinctive gray hue in the captured images. The hazy image is suffers from low contrast and resolution due to poor visibility conditions. One of the central problems in image processing in open air is the presence of cloud, fog or smoke which fades the colors and reduces the contrast of the observed things. Fog or Haze elimination is difficult because the fog is dependent on the indefinite depth information. Weather conditions reduce the operation range of most methods. Consequently, contrast restoration may, of course, improve the operation range of these methods. And By doing this, a high-quality haze free image with clear visibility can be generated.

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