

Haze Removal from Single Image using Image Processing

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Abstract— We have determined that Out of doors pictures might suffer from haze, and therefore the clearness of the image is greatly lost. The haze removal that is understood as dehazing is a crucial issue. during this paper, we are going to propose quick haze removal methodology, that is associate rising version of associate existing methodology victimisation dark channel previous proposed by He et al.. In our projected methodology we ted to consider ablycut back the machine time by rising the tactic to estimate dark channel. Exiting method dark channel estimation methodology uses a down-sampled image and don't need any soft-matting method. Experiments with haze picture shown during this treatise we going to attempt cut back and important methodology is quicker and suitable quality level compared with the present dark channel methodology.

Keywords: Image Dehazing, Image Enhancement

I. INTRODUCTION

We have discovered that treatise self-driving techniques and underwater operating robots have attracted attention over the years. Quick and advanced image recognition technologies square measure needed for such applications. Outside or underwater scene picture square measure greatly lost in image clarity as a result of haze. Therefore, image quality improvement techniques on haze removal (dehazing) are actively studied in recent years.

In this treatise mistreatment dark channel previous. The He's methodology is predicated on applied math previous data that almost all native patches in clear picture contain some pixels that have terribly low intensities in minimum of one colour channel, that is termed dark channel by mistreatment the dark channel previous, the haze are often removed effectively. However, the He's methodology suffer from a heavy draw back in process speed.

A number of strategies are project to hurry up interval processing time Tarel et al., set the visibility restoration rate from one image and project a dehazing methodology mistreatment median filter. However is still can't be used for a processing.

We have Study, proposes a quick removal methodology, that is an associate version of He's methodology mistreatment dark channel previous machine time is considerably reduced by rising the necessity a soft-matting method. Experiments with haze picture show that our project methodology to estimate the dark channel. We are going to attempt to important cut back time dark channel estimation methodology uses a down-sampled image.

II. THEORETICAL RELEVANCE

Haze removal techniques square measure gaining quality thanks to its convenience in several classifications. These strategies are often accustomed construct a prime quality,

noise free, dehaze pictures. The classifications square measure wiped out 2major types' image segmentation and image restoration. Thanks to the presence of fog, mist, haze into the atmosphere the pictures captured of outside might have an scene occasional quality. In several police work and transportation space haze renovation vital task. This approach includes the Renovation is vital task. This approach includes the analysis of scene, extraction of helpful info and so police work the image principally during a weather condition the sunshine that's visible is captivated and is scattered by different particles or raindrops. This epitome engaged in several haze removal approaches and is exhibited as,

$$I(x) = J(x) t(x) + A (1 - t(x)) \quad (1)$$

Where,

I is that the haze image on the 3 R, G and B color channels.

J is that the scene while not

Haze, that the transmission constant to explain the share of sunshine that may penetrate through haze, and A is that the atmospherically light weight mistreatment this atmospherically scattering model to recover the scene J, the most challenge of haze removal is to estimate the atmospherically light weight A and therefore the transmission t from the supply image I properly.

A. Haze Removal Method

Improving the reflected light and avoiding the merging of additional light in the atmosphere. There are several haze removal techniques such as polarization [3,4] , independent component analysis, dark channel prior.

1) Image Segmentation

As the name suggests, image segmentation is the method of segregation of a digital image into multiple segments. The aim of segmentation is to clarify and/or amendment the illustration of a picture into one thing that's and easier to analyse. This system is primarily wont to find objects and limit in picture. Really image segmentation is that the method of distribution a label to each constituent in a picture such pixels with identical label share bound visual characteristic.

2) Image Restoration

Image restoration is that the method of taking a corrupted/noisy image and evaluating the clean original image. The image corruption is caused by several reasons like motion blurs, noise, camera miss-focus image, etc. the method of image restoration is extremely completely different from the conception of image sweetening. Within the image sweetening method, the coming up with of the image is finished to focus on the feature of the captures image ensuing the image additional pleasing to the observer. From a scientific purpose of read there's no necessity to supply realistic information. No previous ways square measure employed in image sweetening techniques that

square measure provided by imaging packages. In reality with this approach, noises are often removed effectively by relinquishing some image resolution. However this development isn't forever accepted several applications. Because it is in visible light Microscope seen the resolution within the z-direction isn't smart. However the image restoration techniques recover the haze image with high quality and brightness. For sick the thing, there should be additional advanced image process techniques out there. Increasing resolution particularly within the axial direction removes noise and increasing distinction.

B. Haze Removal victimization dark channel Previous

A motivating progress in single image haze removal technique is discovered in recent days. The employment of stronger assumptions or previous ways could cause the success of haze removal technique. Completely different completely different researcher's will use different ways to get rid haze from the photographs. In [5], the author has used a soft matting algorithmic program to get rid of the haze. This model is physically invalid and therefore the assumption of constant air light weight could also be unsuitable the daylight is incredibly powerful. Tarel uses image restoration technique to recover the haze. The author in [6], estimates the ratio of the scene and therefore the medium transmission beneath the belief that the transmission and therefore the surface shading are domestically unrelated. This system is physically potential and might offer imposing results. However there some drawbacks of this technique, because cannot dark hazy pictures and it should conjointly fail once the belief is broken.

III. DEHAZING METHOD

Haze Removal Classify Two Categories:

- (1) Multiple image dehazing methodology
- (2) Single Image dehazing Methodology.

A. Multiple Image Dehazing strategies

This methodology prefers 2 or additional pictures or multiple pictures of same scene. It fully avoids unknown and attains notable strategies solely. Clarification of the strategies beneath this class is given below.

1) Weather based mostly methodology

This technique subtilizes multiple images custom made from varied weather circumstances. Within the basic methodology the variations of 2 or additional pictures of same scene area unit thought about. These pictures possess distinct characteristics of the contributory medium on the one hand it enhances visibility however on the opposite hand it conjointly create the user wait until the characteristics of the medium changes. This technique doesn't right away deliver the results. This strategy is additionally unable to handle dynamic scenes.



Fig. 1(a): Hazy Image



Fig. 1(b): Dehaze image



Fig. 2(a): Hazy Image



Fig. 2(b): Clear Weather Image

2) Polarization based mostly

This strategies having completely different polarization however of a similar scene square thought-about. First of all, during this methodology distinct pictures square measure captured by informing a polarizing filter. However the treatment results of dynamic scene isn't dedicated. The demerits of this methodology are:

- It need special INS trumentality like polarizers.
- Applicable to dynamic scene wherever changes square measure additional fast than filter rotation.
- It doesn't furnish higher results.

3) Flow of Image dehazing

Input image Dark channel prior Atmospheric light Modified transmission map Guided filter Scene radiance recovery Haze free image Flow chart of the proposed method.

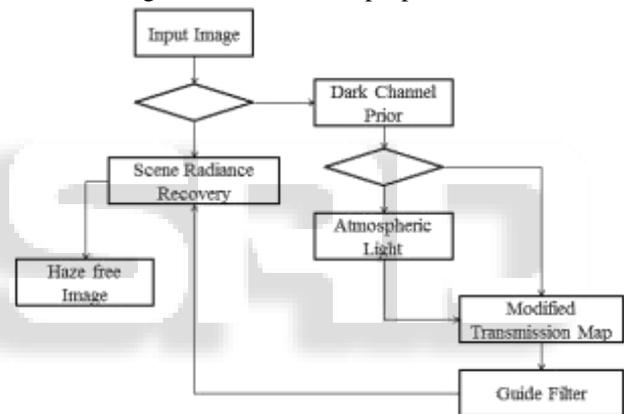


Fig. 3: Flow Chart of the proposed method

4) Depth map primarily methodology

Methodology depth info for haze removal is taken into account. Here we tend to take into account 3D geometrical model (2,10) of scene is given by bound databases like google maps and conjointly considers (from aerial the feel of the scene is equipped photos or satellite pictures). This 3D model aligns hazy image and provides the scene depth [11]. This methodology desires interaction to align 3D model [12] with the scene and conjointly give correct results. During this methodology equipment's don't seem to be The demerits of this methodology are

- This methodology user interaction
- This methodology isn't automatic
- This wants Associate in Nursing estimation of a lot of parameters, and also the additional info harsh to adopt

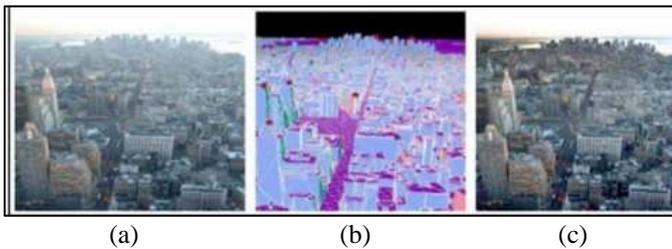


Fig. 4: (a) Hazy Image (b) Structural Model (c) Dehaze Image

B. Single Image Dehazing Method

Unlike previous method this method only want a single input image(1,13). This method depends upon statistical assumption [14] and essence of the scene and it also reclaim the scene data based on last data from single image. This method is now attracting many researchers. Following are the methods which come under this category.

1) Distinction maximization technique

Haze reduces the distinction elimination of the haze increase the distinction of the image. This technique will increase the distinction below the constraint. As this technique doesn't physically enhance depth or brightness, the resultant image have bigger saturation values. The results conjointly represent halo effects at depth discontinuities Figure Distinction Maximization technique a pair of.



Fig. 5: (a) Hazy Image (b) Fixed Image

2) Freelance part Analysis (ICA)

ICA may be a method of dividing 2 further elements from one. this technique is employed by fatal [13] and it's supported the idea that surface shading area unit statistically unrelated in native patch. this approach provides sensible results and physically valid , however one in all the foremost necessary disadvantage of this technique is that it doesn't provide paper lead to case of dense haze.



Fig. 6: (a) Hazy Image (b) Haze Free Image

3) Dark Channel previous

The dark channel previous [14] relies on the statistics of outside haze-free pictures. In most of the non- sky patches, a minimum of one colour channel (RGB) has terribly low intensity at some pixels (called dark pixels). These dark pixels give the estimation of haze transmission. This approach is physically valid and work well in dense haze.

once the scene objects square measure almost like the air light-weight then it's invalid.

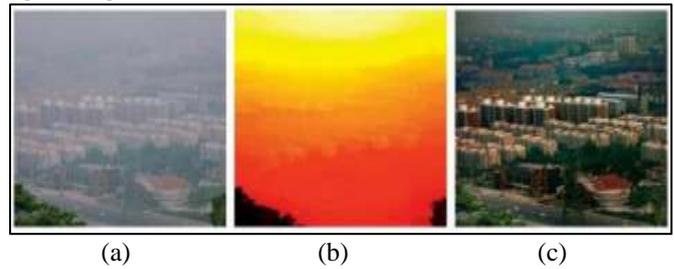


Fig. 7: Dark channel previous (a) Hazy Image (b) Recovered Depth map (c) Haze-free image

4) Related Work

The author Schechter and et al in his paper has given his work that is predicated on the very fact that the scattered air light is part polarized. This air light is scattered by the atmospherical particles. However solely the polarization filtering cannot take away the haze result. Within the projected work, the image formation method is shown wherever the image could be a clean image. The polarization result is taken into account and also the inverting method is employed, wherever it outputs into a haze free image. 2 parts ar wont to compose the image, one is thought as scene radiance and also the different is air light. Scene radiance is within the absence of haze. And air light is that the close light-weight that's scattered towards the viewer. For sick the 2 parts, there's a desire for 2 non-dependent pictures. And these pictures will simply be no heritable as a result of air light is part polarized. This approach is directly applied. It doesn't need the amendment in atmospheric condition. the photographs that ar taken by a polarizer uses the construct of polarization filtering. This polarization filtering is employed in photography across haze. The aim of polarization filtering is to boost the distinction of the input image. In [13] Fatal projected a brand new approach for single image dehazing that attempt to implement haze free image from the hazy image. Fatal developed the refined image formation model that relates to the surface shading and also the transmission operates.

He and et al [14] dark channel previous is predicated on previous assumption. it's been ascertained that in most of the native regions that don't cowl the sky, some pixels have terribly low intensity in a minimum of one color (RGB) channel and these pixels a_r referred to as the dark pixels. In hazy pictures the intensity of the dark pixels in this color channel is largely contributed by the air light and these dark pixels a_r wont to estimate the haze transmission. once estimation of the transmission map for every component, combining with the haze imaging model and soft matting technique [17] to recover a top quality haze free image. Ancuti and et al. [18] is delineated haze is atmospherically term that degrades the out of doors image visibility below the weather condition. This paper describes single image dehazing approach

IV. RESULT COMPARISON

All the input hazy image are taken from the dataset of He et. al. [13] and dataset of Kim et. al.



(a)



(b)



(c)

Fig. 8: (a) Input Hazy Image (b) Our Result without refinement (c) Our Result with Refinement



(a) (b) (c) (d)

Fig. 9: (a) Hazy image (b) $D_{cp} + G_f$ [17] (c) He. et. al [13] (d) Our Result



(a) (b) (c) (d)

Fig. 9: (a) Hazy image (b) $D_{cp} + G_f$ [17] (c) He. et. al [13] (d) Our Result

Image	He et al.	$D_{cp} + G_f$	Our method
Image-1	5.373	0.697	0.388
Image-2	9.888	1.233	0.681
Image-3	15.916	1.898	1.06
Image-4	23.614	2.468	1.486
Image-5	23.653	3.315	2.024
Image-6	42.861	4.733	2.601
Image-7	61.726	5.545	3.299
Image-8	80.144	6.804	4.029

Table. 1: Comparison of Computation time (unit .second)

V. CONCLUSION

This algorithm mainly focused on avoiding block effect at the boundary of the edge and modifies the transmission map to provide haze free and under saturated image, even when haze density is low or high in the input image.

After experiments on different type of hazy image, it is confirmed that the proposed algorithm can accurately estimate the transmission map and effectively avoid the block effect.

The experimental results demonstrated that the performance of the proposed algorithm is best in terms of both computational time complexity as well as quality of the image.

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