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A Novel Haze Removal Approach for Road Scenes Captured By Intelligent Transportation Systems


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Abstract:

The visibility of images of outdoor road scenes will generally become degraded when captured during inclement weather conditions. Drivers often turn on the headlights of their vehicles and streetlights are often activated, resulting in localized light sources in images capturing road scenes in these conditions. Additionally, sandstorms are also weather events that are commonly encountered when driving in some regions. In sandstorms, atmospheric sand has a propensity to irregularly absorb specific portions of a spectrum, thereby causing color-shift problems in the captured image. Traditional state-of-the-art restoration techniques are unable to effectively cope with these hazy road images that feature localized light sources or color-shift problems. In response, we present a novel and effective haze removal approach to remedy problems caused by localized light sources and color shifts, which thereby achieves superior restoration results for single hazy images. The performance of the proposed method has been proven through quantitative and qualitative evaluations. Experimental results demonstrate that the proposed haze removal technique can more effectively recover scene radiance while demanding fewer computational costs than traditional state-of-the-art haze removal techniques.

*Index Terms—****Color shift, dark channel prior, localized light.***

I. INTRODUCTION

The visibility of images captured in outdoor road scenes can frequently experience degradation as a result of phenomena which include absorption and scattering of the light by the atmospheric particles such as haze, fog, mist, and so on. 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. The amount of absorption and scattering depends on the depth of the scene between a traffic camera and a scene point. So, scene depth information is important for recovering scene radiance in images of hazy environments. These techniques can be divided into two groups given depth and unknown depth. Given depth works based on the assumption that the depth is given, this is then used by these approaches to restore hazy images. However, given depth approaches are not suitable for visibility restoration in real world applications due to a serious limitation: the depth information needs to be provided by the user. Unknown depth estimates and there by recover scene radiance in hazy images. These approaches use either

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multiple images and or single images. However, these techniques usually require the use of additional hardware devices and demand more computational complexity. The presence of atmospheric light source add a luminance in area of the hazy image and often causes over compensation .In low complexity wavelength compensation and image de hazing algorithm a method is developed to enhance hazy images, by compensating the attenuation discrepancy along propagation path, and the possible presence is taken into the atmospheric light consideration.

II. EXISTING METHODS

The processing of hazy images focuses solely on compensating either light scattering or color change distortion. Techniques are targeting on removal of light scattering distortion includes image de hazing to restore the clarity of the hazy images. Color change correction techniques estimate the hazy image environmental parameters by performing color registration with consideration of light attenuation. By employing histogram equalization in both RGB and HIS color spaces to balance the luminance distribution of color and dynamically mixing the illumination of an object in a distance dependent way by using controllable multicolor light source to compensated color loss. A systematic approach is needed to take all the factors concerning light scattering, color change and possible presence of artificial light source into consideration. The low complexity wavelength compensation and de hazing algorithm, expensive optical instruments or stereo image pairs are no longer required and this algorithm requires less computational resources and complexity is reduced when compared to conventional Wavelength Compensation and Image De hazing algorithm.

III.PROPOSED METHOD

In This present an effective approach for the haze removal of single images captured during different environmental conditions that not only avoids the generation of artifact effects but also recovers true color. In this method involves three proposed modules, i.e., HDCP module, a CA module and V R module. The HDCP module we are used in low complexity wavelength compensation and image de hazing algorithm first the distances between scenes objects to camera is estimated by using a low complexity dark channel prior algorithm. Based on depth map derived the foreground and background area within image is segmented .The light intensities of fore ground and back ground are the compared, to determine whether an atmospheric light is employed during the image acquiring process. An artificial light is detected; the added luminance is to be eliminated. CA module recovers the true color of the scenes featuring wide range of weather conditions. This CA module determines the intensity statistics for the RGB color space of a captured image in order to acquire the color information .The last step of our process; the proposed VR module recovers a high quality free image. The below fig1 block diagram shows the proposed technique.

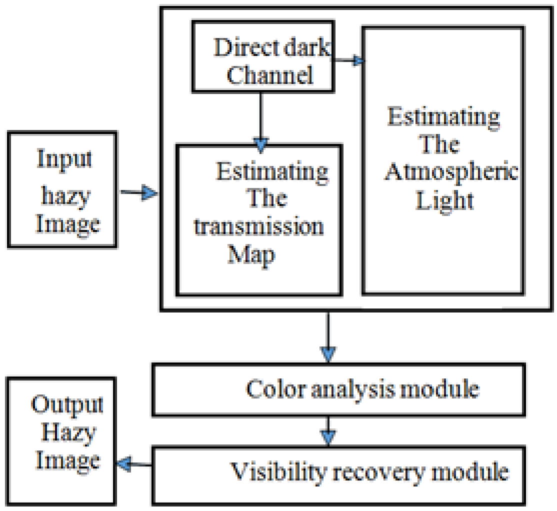

Figure1: proposed technique

1.Dark channel prior algorithm: The dark channel prior is an existing scene depth derivation method, based on the fact that, in most of the background light patches on a haze free image, at least one color channel has a very low intensity at some pixels. The minimum intensity in such a patch should have a very low value called a dark channel. Pixels with a very low value cannot be found in the local patch, which implies

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the existence of haze. The concentration of haze can be quantified by dark channel prior algorithm. It is turn provides the object camera distance, i.e., the depth map The hazy image can be modeled by Radiative Transport equation.

$$I_{\lambda}(x) = j_{\lambda}(x).t_{\lambda}(x) + (1-t_{\lambda}(x))B_{\lambda}(1)$$

Where λ€{red, green, blue} The dark channel can be calculated by using the equation Dark channel=min (Iλ(x)) Where λ€ {red, green, blue} Iλ(x) is the hazy image acquired by camera. The background light B λ is usually assumed to be the pixel intensity with the highest brightness value in an image. The brightest pixel value among all local minima corresponds to the background light follows.

$$B_{\lambda} = \max(\min(I_{\lambda}(x))) \quad (2)$$

The depth map can be calculated by using the formula Depth map = 1-min {median(Iλ(x))/Bλ} The median filter is used to reduce the block effect

2.Image segmentation: The foreground and background areas of the hazy image are segmented based on the depth map derived using threshold. Foreground if d(x)>threshold Background if d(x)<=threshold.

3. Determination of atmospheric light: An atmospheric light can be determined by comparing the difference between the mean luminance of the foreground and background images. Higher mean luminance in the foreground indicates the existence of a supplementary light source.

4. Removal of atmospheric light: For removing the atmospheric light, first the average intensity of both the foreground and background image is calculated .Then take the difference between foreground and background intensity. The next step find the luminosity updated foreground intensity is find out by subtracting the difference intensity from the foreground intensity. Then by adding the updated foreground with the background the image free of atmospheric light is obtained.

5. Compensation of light scattering and color change: After removing the atmospheric light source and deriving distance between an object and the camera, the haze can be removed by subtracting the scattering 1-N_rer^d(x) 1from image perceived by the camera.

6. Color analysis module: The particles of sand in the atmosphere caused by sandstorms absorb specific Portions of the color spectrum. This phenomenon leads to color shifts in image during such conditions, resulting in different color channel distributions. The dark channel prior method uses the same formula for color channel when recovering scene radiance, there serious color channel shifts in restored images. Solve this problem we propose the CA module the is based on the gray world assumption. This assumption relies on the notion that average intensities should be equal in each RGB color channel for atypical image, which is described as

$$R_{avg} = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N} I^{r}(x,y) \quad (4)$$

$$G_{avg} = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N} I^{g}(x,y) \quad (5)$$

$$B_{avg} = \frac{1}{MN}\sum_{x=1}^{M}\sum_{y=1}^{N} I^{b}(x,y) \quad (6)$$

Where Ir(x, y), Ig(x, y), and I b(x, y) captured image in the RGB color channels respectively, and MN represents the total number of pixels in the captured image. Based on this assumption, color spectrum adjust parameters that can be produced for each RGB color channel in order to avoid color shifts in the restored image.

7. VR module: In order to produce a high quality haze free image captured In different environments , the information provided by HDCP and CA modules are combined to effectively recover the scene radiance.

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IV. EXPERIMENTAL RESULTS

The objective of this section is to demonstrate the results of proposed method and comparison with existing method. The below fig.4 shows that the existing method output results. The input hazy image is in applied with DCP module algorithm. Fig.5 shows that the proposed method de hazing and low wavelength compensation algorithms are used. The proposed method is an effective image restoration technique for images captured in wide range of weather conditions is proved based on the performance evaluation. So this algorithm is simple and restore the image quickly.

Figure2:Haze image

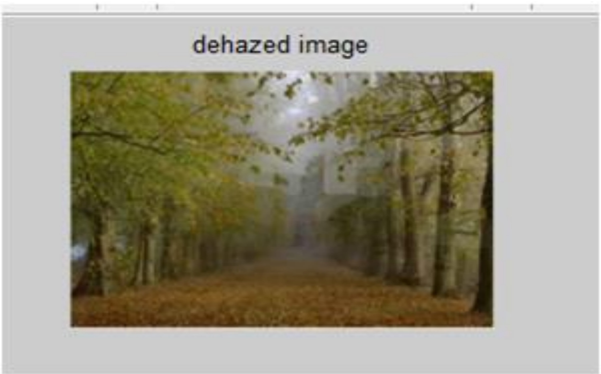

Figure3: De Haze Image

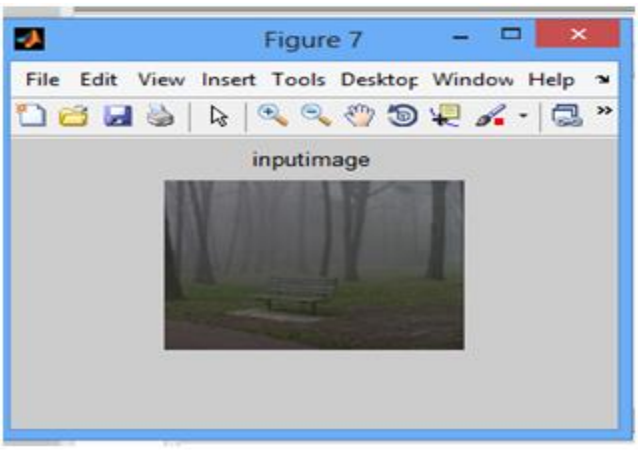

Figure4:Haze image

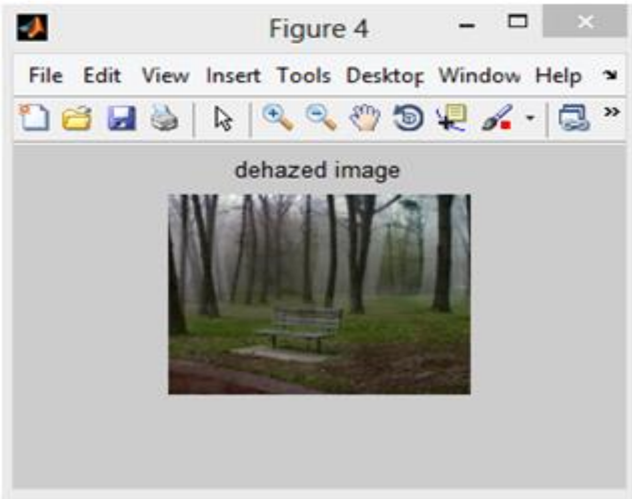

Figure5:De- Haze Image

MOTION DETECTION IN TRAFFIC SURVEILLANCE APPLICATION

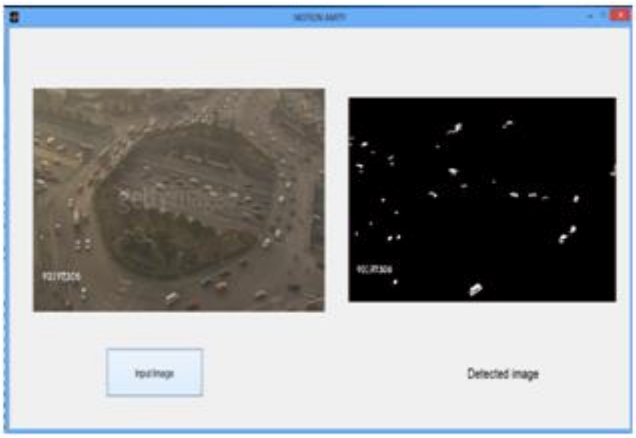

Figure6: Improvement of traffic surveillance applications for a video sequence captured in a haze-filled environment.

PERFORMACE EVALUTION OF PROPOSED SYSTEM

Table1: Parformances of Different images

Input Image	PSNR	Mean difference	Processing speed
lake	7.03	7.912	25.59
toys	8.92	10.035	20.179
city_2	9.518	10.708	18.911
foggy_bench	12.3	13.936	14.53
school	25.598	28.719	7.051

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Table2: Comparision of Different images processing speed (in Frames/second)

Image resolution	Existing method	Proposed method	Fast (percentage)
320x240	20.98	25.59	21.9
480x320	13.06	20.17	54.5
640x480	7.39	18.91	155.89
800x600	4.93	14.53	194.72
960x640	3.81	7.051	85.06

V. CONCLUSION

In this paper, we have proposed a novel approach based on our HDCP technique for haze removal in single images captured under a wide range of weather conditions. First, the proposed HDCP module efficiently conceals localized light sources and, consequently, accurately estimates the position of the atmospheric light. In addition, our HDCP module can provide effective transmission map estimation and thereby avoids the production of artifact effects in the restored image .In the second stage, the proposed CA module uses the gray world assumption to effectively obtain the color information of the captured image and thereby circumvent the color-shift problems in the restored image. In the final stage, the VR module combines the information obtained by the HDCP and CA modules to avoid the generation of serious artifact effects and thus obtain a high-quality haze-free image regardless of weather conditions. The experimental results demonstrate that the proposed technique produces a satisfactory restored image, as measured by the quantitative and qualitative evaluations of realistic scenes, while demanding less computational cost .Moreover, the proposed technique is significantly superior to other state-of-the-art methods. To the best of our knowledge, this is the first study that presents an effective haze removal approach that is applicable in a wide range of weather conditions.

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