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An Improved Adaptive Frame Algorithm for Hazy Transpired in Real-Time Degraded Video Files

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Abstract:

The quality of image captured from the natural environment are often degraded due to the presence of haze, sandstorms, camera on motion, blur, atmospheric turbulence and others. Poor visibility caused by atmospheric phenomena in turn causes issues in computer related applications such as outdoor recognition systems, object detection systems, video surveillance systems, intelligent monitoring systems and others. In order to improve system performance we propose a CLAHE de-Haze algorithm in association with Dark channel prior for removing the haze and improving the quality of an image. Recent researchers have neglected the fact to reduce the noise effects which appears at the output image. But this research work has included WIENER filter to reduce the noise effects present in the output.

Index terms:

Haze removal, Dark channel prior, CLAHE and WIENER filter.

1.Introduction:

Aim to decrease or eradicate the degradation that occurred during capturing the image, Visibility restoration can be considered as the different methods. Degradation is caused due to various factors such as relative motion between camera and object, obscure due to miss focus of camera, relative atmospheric turbulence and others. This proposed concept discusses about the degradations due to awful weather such as fog, haze, rain, snow and dust in an digital image.

The fog is typically differentiated from the term "cloud" among that fog is low-lying [1]. With a view to improve the quality of the image, visibility restoration methods are used. The quality of the digital image of countryside environment in the awful weather condition is usually corrupted by the dispersion of a light before reaching the camera due to the huge quantities of wedged particles like fog, haze, smoke, impurities and others in the environment. This scattering of light is because of attenuation and air-light. The light from the object to be captured gets scattered due to the presence of haze and partially it also travels to the camera and causes deviation in the image being captured. Various haze removal methods are used in order to improve the quality of the image [2] by removing the colour shift.

Haze removal is a challenging task because it depends on the unascertained scene depth information. Hence removal of haze requires the computation of air-light map or depth map. The distance between camera and object is considered as a function of fog effect [3]. Mengyang et al (2009) [1] studied bad weather can degrade the image quality and some methods are proposed to improve it. A novel based dark channel prior is used as a basis principle. After experimental computation about the dark channel prior haze removal, they observed that although dark channel prior reacts effective in most situations, it also shows huge expandable values in some specific situations. Considering all the circumstances, they proposed a monotonous principle to change the color distortion induced by higher diffusion. This type of universal or local alteration can be achieved by ideal compromise between original color and image divination.

Desai et al (2009) [2] studied that current techniques are of peak complexity and is less flexible. Desai et al proposed a innovative fuzzy logic based technique, to improve haze-degraded images. Air-light judgement is carried out using fuzzy concept carried out by color correction for enhanced visibility. Due to its less difficulty compared to other physics based solutions; this method makes run-time application possible on a physical platform which is critic from a road safety point of view. Zhiyuan et al (2009) [3] has suggested that in order to overcome haze effect, a Contrast Limited Adaptive Histogram Equalization based model is applied.

This model creates a peak value to truncate the histogram and readjusts the truncated pixels evenly to each gray-level. It can improve the image contrast while reducing the noise. Proposed model transforms the input image from RGB to HIS and then the intensity component of the HIS image is refined by CLAHE. Later, the HSI image is converted back to RGB image. Jing et al (2010) [7] discussed that imaging in worst weather conditions is often harshly corrupted by dispersion due to wedged particles in the environment like haze. Jing et al proposed an effective dehazing technique for a single input image using wiener filtering method.

Halmaoui et al (2011) [12] has observed that driver guidance systems depend on camera are hardly degraded by the presence of hazy weather. The rejuvenation of these images would enhance the results of such systems as former-processing. He et al (2011) [13] has proposed a efficient method using dark channel prior to make a single input image haze - free. The dark channel prior is a collection of haze-free images. After the key inspection it is observed that most local patches in countryside fog-free images enclose some pixels where its power is very less in atleast a color channel. Using this concept with the haze imaging description, the thickness of the haze in the image is estimated and a enhanced haze-free image is obtained.

Kaiming He et al (2011) [15] has finalized that the dark channel prior is an order of statistics of haze-free images. It relies on a key perception that the most local patches in haze-free images enclose some pixels whose strength is very less in at least a color channel.

2. Related Work:

In this section, we describe the existing works that are closely related with the proposed method.

2.1. Hazy image optical model:

The approximate model of hazy image is described as follows

$$\mathbf{I(h) = J(h)t(h) + [\ A\ (1 - t(h))]} \qquad (1)$$

where I(h) is the observed intensity at pixel h, J(h) is the original haze-free intensity, A is the air-light for the whole image pixels, t(h) is the medium transmission which is considered as a kind of integrating factor to mix the air-light and the original object color. Usually, the distance of the object to the camera increases as the transmission t(h) is decreased. The dehazing is to restore the original image color J(h) by finding A and t(h) at each h.

2.2. Dark channel Prior:

To estimate the atmospheric light in the dehazed image dark channel prior [4] is used to get the more appropriate result. This technique is commonly used for non-sky patches, as at some pixels, at least one colour channel has very low intensity. The low intensity in the dark channel is mostly because of three components:

1. Colourful objects (green grassland, tree, blooms and so on)
2. Shadows (shadows of bus, buildings etc)
3. Dark objects (dark tree trunk, rock)

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As the environmental images are usually full of shadows and colourful objects, the dark channels of these images will be usually dark. Due to fog (air-light), a haze image is more illuminated than its original image without haze. So that dark channel of haze image in the region with higher haze will have higher intensity. So the dark channel intensity is a coarse approximation of the haze thickness. In dark channel prior we can also use prior and later processing steps for getting enhanced results. Some of the processing steps include soft matting or bilateral filtering etc. Let I(x) is original image, H(x) is hazy image, and t (x) is the transmission of the median. The attenuation of image due to haze can be expressed as:

$$H att (x) = I(x)\, t(x) \qquad (2)$$

the effect of haze is Air-light effect and can be denoted as:

$$H airlight (x) = A(1 - t(x)) \qquad (3)$$

Dark channel for an arbitrary image I, expressed as I dark is defined as:

$$I dark (x) = [min / y \in \Omega(x)] \ (min JC (Y)) \qquad (4)$$

In this Jc is colour image comprising of RGB colour space, represents a local patch that has its origin at x. The low intensity of dark channels is predominantly due to shades in images, colourful objects and dark objects in images.

2.3. CLAHE:

CLAHE [5] is Contrast limited adaptive histogram equalization. This method does not need any predicted information about weather for the processing of hazy image. First, the image captured by the camera in hazy condition is transformed from RGB (red, green and blue) colour component to HSI (hue, saturation and intensity) colour component.

The images are converted because the human analyse colours similarly as HSI represent colours. Next intensity component is processed by using CLAHE without having much effects on hue and saturation. This technique uses histogram equalization to a contingent region. The original histogram is truncated and then these pixels are redistributed to each gray-level. In this each pixel intensity is reduced to maximum of user selectable value. Finally, the image processed in HSI colour component is converted back to RGB colour component.

2.4. Wiener filtering:

Wiener filtering [6] is predominantly used to overcome the problems of colour distortion while using dark channel prior method when the hazy images with large white area are processed. While using dark channel prior the value of median function is coarse which produces halo effect in the output image. So, median filtering is used to estimate the median function, so that edges can be conserved. After making the median function more appropriate it is integrated with wiener filtering so that the image restoration issue is transformed into accretion problem. This algorithm is useful to restore the contrast of a large white area for image. The processing time of the image algorithm is also very less.

3.Proposed System Model:

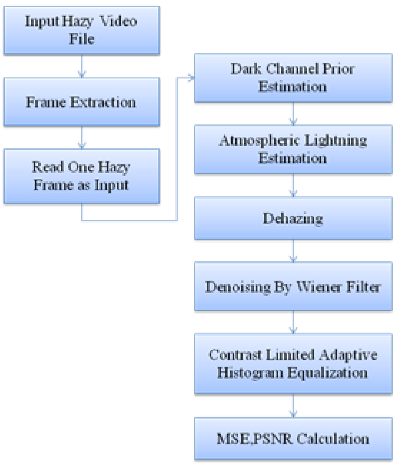

Figure :1 Flow chart

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We propose a method which integrates the two existing methods of Haze removal and Wiener filter is applied to it. It is found that for obtaining enhanced quality of image, the proposed algorithm is more suitable than all other existing methods of haze removal algorithms. In our proposed approach, video file which is transpired with haze is extracted frame by frame and processed by using the proposed CLAHE-dehaze algorithm.

The image quality of outside environment in the haze climatic condition is mostly degraded due to the distribution of a light before reaching the camera because of these large amounts of suspended particles in the air. This interrupts the performance of the regular working of automatic systems .Two phenomena such as attenuation and air-light causes scattering effect.

The current haze removal technique could be classified into two processes: Image enhancement and Image restoration. This method can enhance the contrast of hazy image but loses a part of the data in regards to the image. After analyzing that degradation a model of hazy image will be realized. Finally, the degradation procedure is altered to correct the quality of image and thus haze free image is obtained.

4. Analysis and Computation:

The results produced by the current dark channel prior method have less PSNR value and more MSE value. The ultimate aim is to improve the results by integrating CLAHE with Dark channel prior method. The proposed algorithm is validated on various sorts of images at different circumstances. The algorithm is implemented using some performance parameters such as peak signal to noise ratio (PSNR) and Mean squared deviation (MSD) or Mean squared error (MSE).The utilization of the proposed algorithm has been carried out in MATLAB employing image processing toolbox. The refined concept is validated against a known technique of image dehazing process which is Dark Channel Prior.

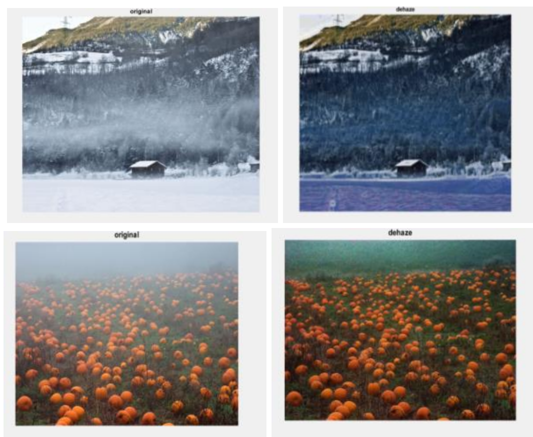
We obtain further enhanced results while comparing proposed approach using some performance parameters. Result implies that our proposed algorithm gives better efficiency than the existing methods. Haze free image is recovered by using below equation as:

opi (j,l,i) =[I(j,l,i) –A/max (t (j,1) ,t0)] +A

Where opi is output image.

5.Result Discussion:

In this section we will compare the results of the original image and the processed image by proposed method. The images of the original and the proposed approaches are shown as under.



(a) (b)

Figure 2: (a) Original image (b) Restored image

The results produced by the current dark channel prior technique have less PSNR value and more MSE value. Therefore the enhanced results are obtained by combining CLAHE with Dark channel prior and hence the performance of the systems is improved.

6. Conclusion and Future Work:

Haze removal algorithms become more beneficial for various intelligent applications.

It is found that most of the existing researchers have neglected many scenarios; i.e. no method is suitable for different kind of circumstances. The existing methods do not consider the fact to combine the use of CLAHE and wiener filter to reduce the noise and uneven illumination problem which will be present in the output image of the existing haze removal algorithms. To overcome the existing problems, a new hybrid algorithm has been proposed that has incorporated the dark channel prior with CLAHE to get further enhanced results.

The outline and implementation of this algorithm is done in MATLAB employing image processing toolbox. In future the proposed algorithm can be modified by combining with some suitable known filters for better results. In this research work we neglected the function of color correction algorithms, so in future we will also make use of some color correction algorithms. The proposed work can also be extended to video dehazing in the future.

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