IMAGE DEHZING: A STUDY

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Abstract

We make an investigation of the dehazing effect of image and video which is affected by bad weather conditions. A video captured in outdoor scenes affects by the presence of haze like fog, mist and dust particles in the atmosphere. We are utilizing a Dehazing algorithm to remove this unwanted haze from videos and Real-time video. For this, we use a Novel method of video dehazing based on contrast enhancement. From our observation it is concluded that hazy image and video has low contrast, so we restore the hazy image and video by enhancing its contrast. This algorithm computes the airlight on an input hazy image and video then we estimate the transmission map to maximize the contrast of output video and image. We establish a better Dehazing performance with fewer artifacts and better coding efficiency and demonstrate that the proposed algorithm can remove haze efficiently and recover the parameters of the original scene.

Keywords*: Real-time video dehazing, image dehazing, restoration, contrast enhancement, Airlight estimation, transmission map, gamma correction.*

I. INTRODUCTION

Recently there has been growing interest in the analysis of video affected by weather phenomena. Haze removal (Dehazing) is highly desired in consumer, computational photography and computer vision applications. The process of removing haze can significantly increase the visibility of the scene and correct the shift caused by the airlight. Video captured in poor environmental conditions fails to present visual effects. Dehazing is the process of removing haze from video and enhancing the video quality so; the main object of our technique is to enhance the poor visibility of the video, which applicable in the field of public safety, traffic accident analysis, crime forensics, remote sensing area and military surveillance. The three main objectives of video enhancement techniques are, to explore the hidden details in the video; the effect such as flickering and uneven exposure should be avoided; the video should be temporally consistent. To achieve all these objectives we propose a contrast enhancement algorithm. Contrast Enhancement commonly used for surveillance applications because the viewing environment is outside the control of the observer. By using this method, unexpected flickers are effectively eliminated. Optical scattering produces an unnecessary exposure on a video and image known as “Airlight”. It happens because of light coming from the source (sun) is scattered to words of the observer. The airlight is firstly estimated in given input scenes (video, image).To compute the scene depth there are several approaches for example scene depths are estimated from two or more image and video which are captured in different environmental and weather conditions. For this, we divide an input scene into multiply blocks and then estimate the optimal transmission for that blocks. So, the contrast of image and video increased. Finally, we apply the gamma correction technique which is used to optimize the usage of bits encoding an image and video. It is an effective tool for manipulating the histogram of an image that is either over an underexposed. In addition to manual control, gamma correction can be also automatically adjusted to compensate for the change in the scene. In an analog video system, gamma correction is performed with analog circuitry and is adjusted manually. With a digital video system, gamma correction can be provided using mathematical operations in digital circuitry. Thus we dehaze an image and video using a contrast enhancement algorithm from hazy video and image to achieve haze-free image and video which is clearly visible for human eyes and greatly impact the accuracy of the message and visual perception.

II. BASIC METHODOLOGY

In this paper, we proposed a methodology that improves the visibility of haze images and video. The Methodology uses the depth estimation concept to restore the degraded image and video. The input image and video which are captured in the outdoor scenes subjected to atmospheric troubles such as haze, fog and heavy rain etc.

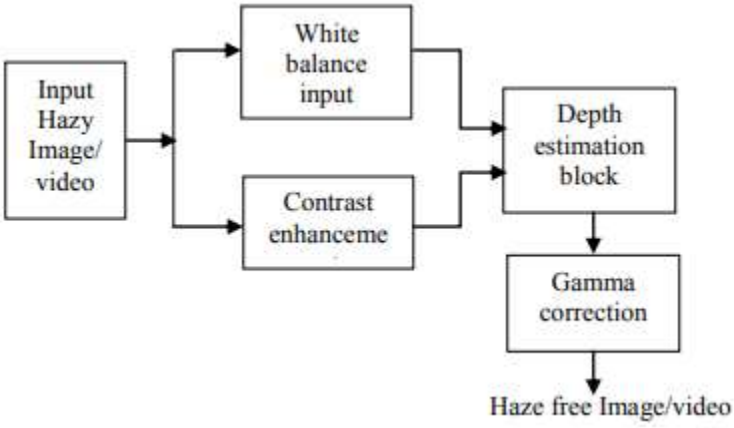

Figure 1. General Block Diagram of Video Dehazing

To identify the colour temperature and the contrast levels the input image and video are converted into the two individual inputs such as white balance input and contrast enhancement. White balance means colour balance. It is a function that gives the camera reflection to „true white". Since white light is the sum of all other colours. The camera will then display all colours correctly. The contrast enhancement process is used to make image and video features more clearly. Contrast manipulation involves a scene to increase the contrast. These two individual images and video are then applied to the depth estimation process involves various segments such as finding the weight maps of individual images and video (for both white balance and contrast enhancement), normalization of weight maps and application of pyramids.

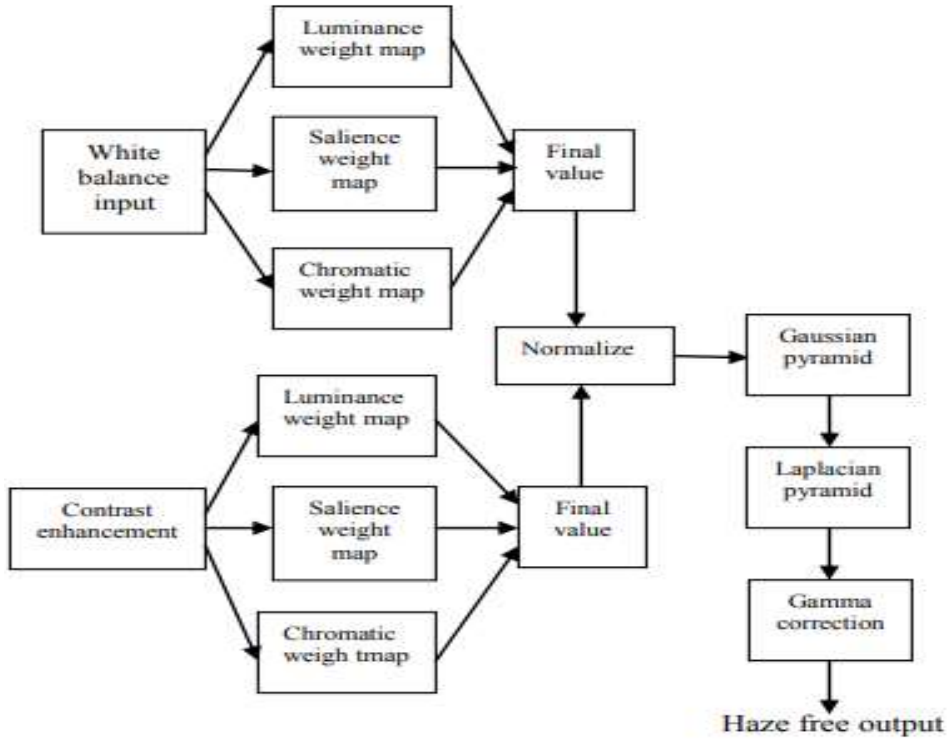

Figure 2. Depth Estimation Process

A gamma correction factor has been applied to the depth estimation process in order to improve visibility which is the perfect scene for the human eye. The gamma correction enhances the contrast level of the image and video and hence even in the high atmospheric troubles we get a visually perfect image and video. Finally, we obtain a haze-free image and video which clearly visible for the human eye and greatly impact the accuracy of the message and visual perception.

Depth Estimation Process: Chromatic weight map controls the saturation gain in image and video, the Salience weight maps define the quality which contributes to degrees of conspicuousness with respect to the neighbourhood region. The output pf each weight map are normalized (change the range of pixel intensity value), and then applied to the Gaussian pyramid of length five. The image and video is a data structure designed to support efficiently scaled convolution through reduced image and video representation. It consists of a sequence of copies of an original image and video in which both sample density and resolution are described in regular steps. The Laplacian pyramid has been described as a data structure composed of bandpass copies of an image and video that is well suited for scaled image and video analysis. But the pyramid may also be viewed as an image and video transformation, or code. The pyramid nodes are then considered code elements, and the equivalent weight function is a sampling function that gives node values when convolved with the image and video.

III. LITERATURE REVIEW

- In 1998, C. Tomasi, R. Manduchi, [1] proposed Bilateral filtering for grey and colour images. Bilateral filtering smooth's image while preserving edges, utilizing a nonlinear combination of nearby image value. It combines, grey levels of colour based on both geometric closeness and their photometric similarity, and prefers near values to distant values in both domain and range. Filtering is perhaps the most fundamental operation of image processing and computer vision. The intuitions of that image typically very slowly over space, so pixels are likely to have similar values, and it therefore appropriate to average them together. In this paper, a non-iterative scheme for edge-preserving smoothing is non-iterative and simple. It allows explicitly enforcement of any

desired notation of photometric distance, which is particularly important for filtering colour images. It combines is much more interesting, which is denoted as bilateral filtering. Bilateral filtering can be applied to colour images just. The CIE-lab colour space endows the space of colours with short Euclidian distance correlates strongly with human colour discrimination performance. Here only perceptually similar colour is averaged together; only perceptually visible edges are preserved.

- In 2001, Y. Y. Schechner, G.Narsimhan and Shree K. Nayar [2] proposed a technique of Instant dehazing of the image using polarization. They present a method that removes the haze from images that are affected by atmospheric particles, which is polarized. They obtained the hazed image and scene structure information through a model which is affected by polarization effects of atmospheric scattering. Because of air molecules and small dust particles polarization effects are explores, to remove this effect image is captured through a polarizing filter which is settled parallel to the plane. They obtained the range map of images. In that, darker points are used to indicate more instant objects. This will becomes helpful in the field of photography and remote sensing. But this method is less effective in the case of overcast sky and the presence of very dense haze or fog.
- In 2003, S. G. Narasimhan and Shree K.Nayar proposed a [3] Contrast Restoration of Weather Degraded Images. This paper presents a physical-based model in uniform bad weather conditions. Change in intensities of present scene point under the bad weather conditions provides the simple constraint to detect depth discontinuities in the scene. And also compute the scene structure than a fast algorithm to restore scene contrast is present. All the methods described in this paper are effective under a wide range of weather conditions in which including haze, fog, mist. Further, this method can be applied to greyscale, RGB colour, multispectral and IR images. This method does not apply to real time to obtain weather free video. This method cannot be used to restore the contrast of moving objects or videos. In which used the off-the-shelf 8- bit digital video camera.
- In 2006, S. Shwartz, E. Namer, Y. Y. Schechner published a paper on [4] Blind Haze Separation This paper proposes an approach for blind recovering parameters needed for separating the airlight from the measurement, thus recovering the contrast with neither user interaction nor the existence of the sky in the frame for analyzing haze images, an effective approach is based on polarization. Which measures pixels that correspond to the sky by the horizon, thus estimation relies on the existence of such image part in the field of view (FOV). This method blindly separates the airlight radiance from the object signal it works even if no sky exists in the FOV. The method exploits mathematical tools developed in the field of Blind Source Separation (BSS), which also known as independent component analysis (ICA) which is based on colour cues Here obtaining the blind parameter estimation which was consistent with direct sky measurement, consequently, dehazing showed significant improvement of visible and colour reactive to the raw data.
- In 2007, J. P. Oakely and H. Bu proposed [5] a Correction of simple contrast loss in the colour image. An algorithm is proposed which described for estimating the level of the airlight given the assumption that it is constant throughout the image. It finds the minimum of a global cost function and applies to both monochrome and colour images. The performance of the algorithm is explored using the Monet Carlo simulation with synthetic images under different statistical assumptions. The outdoor scene of the image will often be degraded by optical scattering of light caused due to fog or mist which produces additional lightness present in some parts of the image, this effect is referred to as atmospheric background radiation or airlight. In this paper mitigation of simple contrast loss of image is happened, which caused by parameters added in the image while captured by the camera. In simple contrast loss, the degradation by described. A physical-based method is proposed to restore simple contrast loss due to a scattering medium and another source of light. The first method provides accurate contrast restoration of a colour image in the scene that processed foggy image is similar to one taken in clear condition. A method has been proposed for the determination of airlight level in digital images, which involves the minimization of a scalar global cost function and no region segmentation is required and simple contrast loss is easily corrected. The accuracy of the method under ideal conditions has been confirmed with a synthetic image model. The method applies to both black and white images, colour images.
- F. In 2008, Robby T. Tan published a paper on [6] Visibility in Bad Weather from a Single Image. This paper proposes an automated method that only requires a single input image, which is based on two basic observations; first, images with enhanced visibility (or colour-day) have more contrast than images plugged by bad weather. The second airlight, whose variation mainly depends on the distance of objects to the viewer, tends to be smooth. This method does not require the geometrical information of input images and it is applicable for both colour and

grey images. In bad weather conditions, poor visibility is a major problem for many applications of computer version, which are most automatic systems for surveillance, intelligent vehicles, outdoor object recognition etc. The light from the atmosphere and the object are observed and scattered by those particles, causing the visibility of the scene to be degraded. In this method, an input image is given which estimate the atmospheric light from which we obtain the light chromatically. Then the light colour removes from the input image and the data is computed. So this paper proposes a method that is solely based on single images without requiring the geometrical structure of neither the world nor any user interactions. So, the method is proposed that is solely based on the single image without requiring the geometrical structure of the world nor any user interactions. This is applicable for outdoor surveillance systems, intelligent vehicle systems, remote sensing systems, graphics editors, etc.

- G. In 2009, K. He, J. Sun, X. Tang [7] proposed a paper on Single image haze removal using the dark channel prior method. In this project, they removed the haze from a single image using the dark channel prior method. By using this method, they obtained haze thickness and so get a high-quality haze-free image. Images are mainly absorption and scattering. Because of this reason, the image losses its contrast and colour fidelity. So, by clearing this effect of atmospheric i.e., haze the image will visible clearly and increases its contrast. They enhanced the contrast of the restored image. This method is also applicable to a distant object which is in heavy haze. But, it is similar to airlight in a large region. They used 3D models and texture maps of the image to remove the haze from the image
- H. In 2011, J-Hwan, J-Y Sim, C-Su, Kim, [8] proposed a Single image dehazing based on contrast enhancement. An algorithm is proposed on the single image using contrast enhancement. This algorithm is applied to a single hazy image. The first step is airlight estimation which is based on the quad-tree subdivision. Next, estimation of optimal transmission is done to enhance the contrast of the restored image. Ambient light in the atmosphere is nothing but airlight. It is considered as brightest colour in the image. They used the hierarchal method based on quad-tree subdivision to estimate airlight. The algorithm estimates space varying transmission values. For that input image is divided into many blocks is estimated to enhance the contrast of the image. By developing a low complexity algorithm we can apply it on video also as it requires more power than a single image.
- In 2016, Feng Yu, Chunmei Qing, Xiangmin Xu, BolunCai, proposed an [9] Image and video dehazing using View-based cluster segmentation. A view-based cluster segmentation method is utilized to avoid distortion in sky regions and make the sky and white objects clear. Here firstly GMM (Gaussian Mixture Model) is utilized to cluster the depth based on distant view to estimate the sky region and distant view to estimate is modified to reduce distortion. Secondly, a Single haze image is divided into „K- classifications", finally, an online GMM cluster is applied to video dehazing. Here this method is proposed by using GMM cluster and colour attenuation prior for the depth map and the haze image separately the transmission estimation and atmospheric light estimation and modified using the view-based cluster segmentation to decrease colour distortion and improve global contrast; video dehazing algorithm is presented by using online GMM cluster. The global brightness of sequence dehaze image is increased and finally, the video dehazing method is proposed, which can restore hazy video by saving a lot of time for the cluster of a sequence of video.
- J. In 2018, Yongmin Park, Tae-Hwan Kim, proposed [10] a Fast execution scheme for dark-channel-prior based outdoor video dehazing. It realizes the fast execution of the dark-channel-prior method targeting the outdoor video dehazing. The overall execution time is reduced by up to 49% while dehazing quality is maintained to that of the original method. The signal processing used to remove haze is called dehazing. The density of the haze of the image is non-uniform for every pixel of the image. So detecting the dark pixel of the image removes its haze. The camera captures the hazy image and detects the location of the airlight. To measure the contrast develops a cost function, which consists of standard deviation term and histogram uniform term. Finally, the experimental result demonstrates that the proposed algorithm can remove haze as well as reconstruct the details in the original scenes more clearly.

A comparison of all the above papers is shown in Appendix -1

IV. CONCLUSION

Analysis of Video and Image affected by a weather phenomenon and environmental conditions (nothing but Haze), an algorithm is proposed as, "Contrast Enhancement". Contrast enhancement is a process that makes the video and image features stand out more clearly by making optimal use of the colours available on the display or output device. This algorithm is applied to the Image and video and then we move towards the Real-time video, which can be used in surveillance systems, in the field of public safety. Video and Image quality can be clear by estimating the airlight. Then, the depth estimation process is used to identify the depth information of the given input. Finally, the gamma correction technique is used to clear the quality or visual perception of images and video. Hence finally we have a result of pure, clear image and video which is visible to the human eye.

Appendix -1

Author & year	Paper title	Technique used	Advantages	Disadvantage
C. Tomasi, R. Manduchi, 1998	Bilateral Filtering for grey and colour images	Bilateral filtering and non-iterative	Applicable for images	Not applicable for black-and-white ones.
Y. Y. Schechner, S. G. Narasimhan, S. K. Nayar, 2001	Instant dehazing image using polarization	Polarization technique	Helpful in the field of photography and remote sensing	This method is less effective in the case of overcast sky and the presence of very dense haze or fog
S. G. Narasimhan, S. K. Nayar, 2003	Contrast restoration weather degraded images	Physical-based method to recover blind parameter	The method is applicable for greyscale, RGB colour, multispectral, IR image	The problem of restoring the image the contrast of the automatically degraded image
S. Shwartz, E. Namer, Y. Y. Schechner, 2006	Blind haze separation	Polarization technique	Dehazing showed significant improvement of visibility and colour, reactive to the raw data	The problem of restoring the contrast of the atmospherically degraded image and video
J. P. Oakley, H. Bu, 2007	Correction of simple contrast loss in colour image	Physical based method	This method is applicable for both black and white and colour images	Considered the bright parts of the image, hence this algorithm does not give a good result
R. Fattal, 2008	Single image dehazing	Automated method	Solely based on single images, without requiring the geometrical structure	Some halos are surrounding the trees in the image.
K. He, J. Sun, X. Tang, 2009	Single image haze removal using dark channel prior	Dark-channel-prior method	To remove haze from a single input image dark-channel prior method is proposed	Incapable for sun influence in sky region and bluish hue near the horizon
Jin-Hwan Kim, J-Y Sim, C-Su Kim, 2011	Single image dehazing based on contrast enhancement	Contrast enhancement	To estimate a space varying transmission map to dehaze an image	----

Feng Yu, Chunmei Qing, Xiangmin Xu, Bolun Cai, 2016	Image and video dehazing using view-based cluster segmentation	View-based cluster segmentation	Avoid the colour distortion in the sky region and make the sky and white object clear	If the static analysis method is used to dehaze the video, then it will take a lot of time to process
Yongmin Park, Tae-Hwan Kim, 2018	Fast execution scheme for dark channel-prior based outdoor video dehazing	Dark-channel-prior method	Realize a fast dehazing system targeting outdoor video streams	----

V. REFERENCES

[1] C. Tomasi, R. Manduchi, "Bilateral filtering for grey and colour images", In Proc. IEEE ICCV, pp. 839-846, January 1998

[2] Y. Y. Schechner, S. K. Nayar, "Instant dehazing o image using polarization", In Proc. IEEE CVPR, vol. 1, pp. 325-332, December 2001

[3] S. G. Narasimhan, S. K. Nayar, "Contrast restoration of weather degraded images", IEEE Trans. Pattern Anal. Mach. Intell., Vol. 25, pp. 713-724, June 2003.

[4] S. Shwartz, E. Namar, Y. Y. Schechner, "Blind Haze separation", IEEE CVPR vol. 2, pp. 1984-1991, June 2006.

[5] J. P. Oakley, H. Bu, "Correction of simple contrast loss in colour image", IEEE Trans. Image Process., vol. 16, pp. 512-522, Feb 2007.

[6] R. Fattal, "Single image dehazing", ACM Trans. Graph, vol. 27, no. 3, pp, 1-9, August 2008.

[7] K. He, J. Sun, X. Tang, "Single image Haze removal using dark channel prior ", IEEE CVPR, pp. 1956-1963, June 2009

[8] Jin-Hwan Kim, J-Y Sim, X. Tang, "Single image dehazing based on contrast enhancement", IEEE, International Conference on Acoustics, vol. 7882, no. 1, pp. 1273-1276, 2011.

[9] Feng Yu, Chunmei Qing, Xiangmin, Xu, Bolun Cai, "Image and video dehazing using view-based cluster segmentation", 2016

[10] Yongmin Park, Tae-Hwan Kim, "Fast execution scheme for dark-channel-prior outdoor video dehazing", IEEE, ACCESS, vol. 6, pp. 10003-10014, March 2018.

[11] M. Gopika, M. Sirisha, "Visibility Enhancement of hazy image using Depth Estimation Concept", IRJET, vol. 4, Issue. 7, pp. 3300- 3305, July 2017.