

Improvement in Contrast Restoration for Fog Images using NBPC

Chaithanya Karnad¹, Sudarshan K²

P.G. Student, Department of Computer Science and Engineering, Srinivas Institute of Technology, Mangaluru,
Karnataka, India¹

Associate Professor, Department of Computer Science and Engineering, Srinivas Institute of Technology, Mangaluru,
Karnataka, India²

ABSTRACT: Images are frequently debased by air dimness, a wonder because of the particles noticeable all around that disseminate light. Dimness actuates lost contrast, its visual impact is obscuring of far off articles. Removing fog from images can significantly increase the visibility of the scene and is more visually pleasing. So current image processing application is delicate and error prone. In this paper we propose a single efficient algorithm that will enhance and restore the fog free image. The proposed method is used with other filters to compare the performance on image. The proposed algorithm is able to perform image enhancement for both color images and greyscale images. Fog free image is obtained by removing the estimated airlight from the degraded image. Here we use a mathematical model to compute the atmospheric veil. Then the performance of algorithm is tested and a comparative study is made with other algorithm.

KEYWORDS: Fog, Image enhancement, Image reconstruction, Filters.

I. INTRODUCTION

Distinctive weather condition can reduce the images quality and visibility distance of an object will also be reduced. Some weather condition is fog, haze, mist, rain etc. Also image taken during weather condition reduces the contrast of an image and results in change of colors. In terrible climate, the brilliance from a scene point is fundamentally changed because of air diffusing. The measure of scrambling relies on upon the separations of scene focuses from the eyewitness. In this way, restoring clear day contrast and shades of a scene from a solitary picture taken in terrible climate is intrinsically under-compelled.

Image Enhancement is the change of computerized image quality, without learning about the wellspring of debasement. The point of picture preparing is to utilize information contained in the picture to empower the framework to comprehend, perceive and decipher the handled data accessible from the picture design. In addition the scrambling effect of the transmitted light causes additional daintiness in parts of the image. This is called as Atmospheric veil. This climate condition is particularly uncertain in driving circumstances, since drivers tend to overestimate the perceivability separation while going in fog conditions and drive with over the top rates. Because of the existence of fog, the perceptibility separation attenuate exponentially, in this manner making fog a standout amongst the most hazardous climate conditions for driving. Different algorithm has been proposed to restoration of contrast of an image and to enhance image. There are two techniques can be classified as follows:

Model based Enhancement Technique and Non-Model based technique. Non-model based techniques perform image upgrade depending just on the data got from the image: such as histogram equalization and adaptive histogram equalization. This approach is based on Retinex Theory.

Model based contrast restoration techniques can be further divided in two categories: [1] with given depth and unknown depth. At the point when the depth should be known, this data can be utilized to restore the original contrast of an image. The authors have in examined distinctive fog evacuation approaches based on given depth data. The depth is induced by utilizing the elevation, tilt and position of the camera through the manual guess of the sky territory and vanishing point in the caught image or by approximating the geometrical model of the examined image scene. Since the

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

depth data is given by the user in all these previously stated approaches and in light of the fact that the acquired depth data is incorrect and untrustworthy, these strategies are not able for real application.

Different authors attempt to appraise the depth from foggy images and perform contrast restoration with acquired depth. The depth is estimated by combining the flat world assumption for the points that belong to the road surface and a depth heuristic for the focus over the road surface in an iterative rebuilding approach. Strategies for restoring contrast without depth data all utilize the solitary image for performing image improvement and mathematical model that describe the fog in image. Computation restoration technique can be utilized as part of wide range of uses beginning from the computational photography field. If the restoration algorithm is performed in real time, then image improvement can likewise be connected for constant pc vision application, for example essential image defogging, traffic surveillance, driving help etc.

In request to beat these obstacles we should either adjust the working parameters of the camera or attempt to distinguish the vicinity we should either adjust the working parameters of the camera or attempt to distinguish the vicinity of fog and expel its belongings from the images. Here we focus on second approach, especially restoring and enhancing the quality of original foggy image.

II. RELATED WORK

In S. G. Narasimhan and S. Nayar [2] they address the problem of how to deweather a single image of scene without using particular weather or depth information. Here they begin by analysing two scattering models that describe the colors and contrast of a scene under a bad weather conditions. These models are used Interactive methods to deweather, and add weather to images. Based on these models, they present a three algorithm to correlative deweather a single image. In every one of these cases, the user gives straightforward inputs through a visual interface to physical-based algorithm for restoring contrast and color of scene. In these they provide depth heuristics and sky intensity. Then segment the light source in image. This step cal also is done automatically using a simple thresholding operation on image intensities. The three algorithms used here are easy to use and can effectively restore clear day colors and contrast from poor weather image .Advantage of this method is that it does not require exact information about scene or the climate condition. But it has disadvantaged that is, since user gives the information about depth, it may be erroneous.

In J. P. Tarel and N. Hautière, [3], they propose a novel algorithm for visibility restoration based on filtering approach. It applies the visibility restoration algorithm; perform some estimate of atmospheric veil, smoothing handle noise amplification and final tone mapping. They introduce an original filter called Median of Median along lines which are able to preserve edges as well as corners with thick angle. Finally step to do is tone mapping. The same tone mapping technique is critical to permit the visual examination of the subsequent pictures got by various perceivability restoration algorithms furthermore for examination with the unique picture. They do the qualitative comparison of image and quantitative evaluation on images. Its main advantage is its speed since its complexity is only a linear function of the input image size and also achieves as good or even better results. One more advantage is its ability to better remove the fog in the bottom of first image and at long distance in second image.

In J. P. Tarel, N. Hautière, A. Cord, D. Gruyer, and H. Halmaoui[4], they amplify the algorithm by considering that an extensive part of the picture is the planar street. The new algorithm makes great utilization of planar road assumption and in this way can likewise be seen as the mix of the local visibility enhancement algorithm with road specific enhancement algorithm. The primary thought in the new algorithm is to consider the street plane before the vehicle, as another third requirement. The acquired calculation is suitable for camera-based ADAS utilizes since it can process dim level and also shading pictures and runs close to real time. The proposed algorithm also exhibits its ability to improve visibility in such difficult heterogeneous situations. The obtained results are compared with other algorithms like multiscale retinex and enhancement with free space segmentation. A near study and quantitative assessment with other best in class algorithms is proposed on synthetic images with few sorts of produced fog, This assessment exhibit that new algorithm produces comparative quality results with homogeneous fog and that it can better arrangement with the vicinity of heterogeneous fog.

K. He, J. Sun, and X. Tang,[5] in these they proposed a simple but effective image prior called "Dark channel prior" to remove the haze from an solitary image. The dark channel prior is an inquiry property of an open haze free images. The most fixes in these images pictures ought to contain pixels which are dark in no less than one color channel.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

Utilizing this prior with a haze imaging model, we can without much of a stretch recover top notch haze free images. Tests exhibit that this basic earlier is effective in different circumstances what's more, outflanks numerous past methodologies. In order to solve the time consume step in haze removal, they proposed a unique technique. The first one is an unconventional large-kernel-based linear solver. The second one is a generic edge-aware filter which enables real-time performance. This filter is superior in various applications including haze removal, in terms of speed and quality. Although these method work well and obtained result is good this approach is very costly from the processing point of view because optimization algorithm is used.

In J. Oakley and H. Bu [6] are concerns with the relief of basic differentiation misfortune because of included lightness in a picture. This additional lightness has been alluded to as "airlight" in the writing since it is regularly brought on by optical diffusing because of mist or fog. A statistical model for scene substance is detailed that gives a method for identifying the vicinity of airlight in a self-assertive image. Algorithm assumes that airlight present on whole image is uniform. This algorithm depends on finding the base of minimal of global cost function cost work and is pertinent to both monochrome and color images. The technique is powerful and uncaring to scaling. Once an evaluation of airlight is accomplished, then image adjustment is clear. The execution of the algorithm is investigated utilizing the Monte Carl simulation with synthetic images under various analytical suppositions. A few samples of previously, then after the fact shading pictures are given. Results with genuine video information got in poor perceivability conditions show casing to-edge consistency of superior to anything 1% of most extreme level. Methods presented here are not suitable for real time applications.

In L. Caraffa and J.-P. Tarel, [7] they proposed a MRF model to solve the stereo reconstruction and image defogging in daytime fog. This model is an extension of other two models that is classical stereo reconstruction without fog and newly introduced image restoration when the depth is known. The proposed method also includes the photometric constraint and assumption on white pixels. When the photometric is applied on atmospheric veil, it must be verified on the left and right images of the stereo pair. They evaluated the stereo reconstruction in foggy weather by relaying only on synthetic images since it's difficult to have the 3D model of scene and images of this scene with and without fog. It prompts the enhancement of a power which can be unraveled by a substitute plan in view of the use of progressive α -expansion optimization. The merging towards a nearby least is along these lines ensured. The obtained results are good.

III. PROPOSED METHOD

In order to compute the atmospheric veil for color images, we use as the input to our algorithm a gray level image L that consists in the minimum of each color channel (R, G, B). This image is called the dark channel prior of a color image [4]. The obtained veil V provides the amount of white that must be subtracted from each color channel. $L = \min(R, G, B)$ for color images, $L = I$ for monochrome images.

In order to derive a atmospheric veil, properties of atmospheric veil must be analyzed, first is that photometric constraint[9], atmospheric veil must be higher or equal to zero and v must be lower than L . Another property to be considered is smooth function. Here idea is to estimate the additional lightness in image and then to use it in order to calculate the original fog free image [1].

$$R = \frac{I - V}{I - V / A_0} \quad (1)$$

The above equation(1) states that one way to obtain a fog free image, without knowing the depth of scene, is to calculate the atmospheric veil. The intensity of sky (A_0) is considered to be equal to 255 if considering an 8-bit input image or it can be derived as the maximum intensity of an image and to calculate the average intensity inside this rectangle as the sky's intensity.

Additional scattering of light on image is not uniform, especially true in the case of real world images where there is greater variation in fog density. The figure 1 shows the enhancement and restoration of a fog image. For given an input foggy image, first step is to perform the image preprocessing, then no black pixel constraint algorithm will be applied on an image. During image visibility restoration, the more atmospheric veil is important, the more contrast is increased. This leads to the increasing noise and ruin the original image. To soften the noise on image and to avoid ruining of an image, matting Laplacian matrix is used. Transmission estimate and radiance are applied to get the original value of an image or to restore the original contrast of an image.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

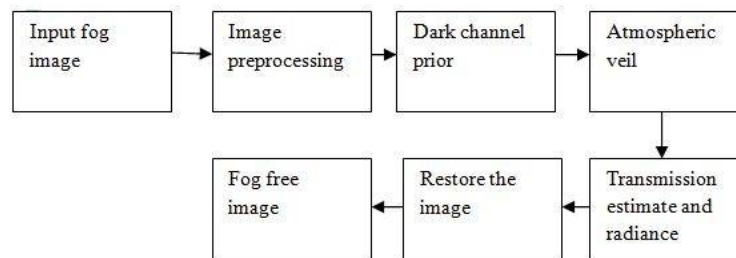


Fig 1: System architecture of proposed enhance method technique

In [4] no black pixel constraint (NBPC), an algorithm which relies on a local regularization is proposed. The distance being unknown, the goal of the visibility enhancement in a single image can be set as inferring the intensity of the atmospheric veil. Most of the time, the intensity of the sky A_0 corresponds to the maximum intensity in the image, and thus A_0 can be set to one without loss of generality, assuming the input image is normalized. Here introduces a new constraint which focuses on the reduction of number of black pixels constraint and states that local standards deviation of enhanced pixel around a given pixel position must be lower than its local average.

Atmospheric veil is modeled with an exponential filter which gives better result. Exponential filter are used because of their condition being unchanged and good shape in relationship with agreement among fog condition. Taking whole atmospheric veil as an exponential function that can be used to better control shape of a final atmospheric veil. Different methods are applied on NBPC algorithm like square and modulus exponential function, translated squared exponential function and translated modulus exponential function. The exponential filter used will be applied along the columns of an image. Adaptive gamma technique has been used to compare the performance with NBPC algorithm. Adaptive gamma technique [8] with respect to the color constraint can automatically enhance the contrast of an image. Gamma encoding of pictures is utilized to enhance the use of bits when encoding a picture, or data transfer capacity used to transport a picture, by exploiting the non-straight way in which people see light and shading two of the error metrics used to compare the various image compression techniques are the Mean Square Error (MSE) and the Peak Signal to Noise Ratio (PSNR). The MSE is the cumulative squared error between the compressed and the original image, whereas PSNR is a measure of the peak error. Peak signal-to-noise ratio measures in decibels the quality of the result image compared with the original image. The higher PSNR shows the better the quality of image. Then mean square error is computed on given image. Normalize correlation is used to measure quality of an image after recovery procedure.

IV. EXPERIMENTAL RESULTS

The proposed algorithm is needed to perform preprocessing on given input foggy image. Also it needs the estimate the amount of additional scattering light present in the image. Transmission and radiance method are applied to remove the fog from image. Then soft Laplacian matrix is applied to restore the original contrast of an image. The proposed enhancement algorithm is compared with the other algorithm. Finally it should provide fog free image with true color of an image. The algorithm used in proposed method gives the best result compared to the existing algorithm.

V. CONCLUSION

Enhancement algorithm was proposed by considering into account the exponential extinction present in foggy images. The proposed visibility enhancement algorithms perform better than the other algorithms such as adaptive gamma technique. The methods using the squared and modulus translated exponential function gives the best result for image enhancement in fog condition. Using PSNR and MSE it shows that proposed algorithm gives the better original contrast of an image after pre-processing, reconstruction and restoration on fog image. The advantage of proposed algorithm is that it is able to perform contrast restoration for both color image as well as greyscale images.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Special Issue 10, May 2016

REFERENCES

- [1] Mihai Negru, Sergiu Nedeveschi ,Radu Ioan Peter, “ Exponential Contrast Restoration in Fog Conditions for Driving Assistance” Assistance VOL. 16, NO. 4, AUGUST 2015.
- [2] S. G. Narasimhan and S. Nayar, “Interactive deweathering of an image using physical models,” in Proc. IEEE Conjunction ICCV Workshop Color Photometric Methods Comput. Vis., Oct. 2003, pp. 996–1001.
- [3] J. P. Tarel and N. Hautiere, “Fast visibility restoration from a single color or gray level image,” in Proc. IEEE 12th Int. Conf. Comput. Vis., Sep. 2009, pp. 2201–2208.
- [4] J. P. Tarel, N. Hautière, A. Cord, D. Gruyer, and H. Halmaoui, “Improved visibility of road scene images under heterogeneous fog,” in Proc. IEEE IV, Jun. 2010, pp. 478–485.
- [5] K. He, J. Sun, and X. Tang, “Single image haze removal using dark channel prior,” IEEE Trans. Pattern Anal. Mach. Intell., vol. 33, no. 12, pp. 2341–2353, Dec. 2011.
- [6] J. Oakley and H. Bu, “Correction of simple contrast loss in color images,” IEEE Trans. Image Process., vol. 16, no. 2, pp. 511–522, Feb. 2007.
- [7] L. Caraffa and J.-P. Tarel, “Stereo reconstruction and contrast restoration in daytime fog,” in Proc. ACCV, Daejeon, Korea, 2013, vol. 4, no. 7727, pp. 13–25, LNCS.
- [8] Shih-Chia Huang, Fan-Chieh Cheng, and Yi-Sheng “Efficient Contrast Enhancement Using Adaptive Gamma Correction With Weighting Distribution “ VOL. 22, NO. 3, MARCH 2013.
- [9] R. Tan, “Visibility in bad weather from a single image,” in Proc. IEEE Conf. CVPR, Jun. 2008, pp. 1–8.