International Journal of Recent Trends in Engineering & Research
ISSN (ONLINE) : 2455 – 1457
IMPACT FACTOR : 4.101

A SURVEY ON THE ENHANCEMENT OF HAZY IMAGES

Ritesh Tiwari[1], Prof. Anil Khandelwal[2]
[1]M.Tech – Student MT - DC, VNS Bhopal
[2]Electronics &Communication,Engineering, VNS Bhopal

Abstract - Due to the adverse weather conditions like the presence fog or heavy rain, digital images are easily subjected to a wide variety of disturbance during acquisition, which may reduce visual effect and affect post-processing of the image. Images degraded by fog adversely affect the quality of vision-based physical security system. This leads to accidents in air, on sea and on the road. However, for improving the image appearance to a human viewer, or to convert an image to a format better suited to machine processing, enhancing methods should be used. After enhancement is again restored the enhanced image by restoration methods. For improving the visibility level 4 major steps are used. These steps are image acquisition, image estimation, image enhancement and image restoration. The main goal of the paper is given an overall existing review for the foggy image enhancement techniques with some future references.

Keywords - Image Enhancement, Image Acquisition, Foggy Weather, Scattering Phenomenon

I. INTRODUCTION

Fog is a collection of ice crystals or water droplets or draped in the air at or near the earth surface. Fog in form of cloud is known as stratus cloud. Fog is prominent from mist only by its density. Fog reduces visibility to less than 1km where as mist reduces visibility to no less then l km [1].

Fog reduces visibility and contrast level of an image. To improve the quality of images various enhancement methods are used. A step by step image processing is applied over an image. Firstly acquire the image from real world and convert into system readable form, measurement of the effect of noise on the image. There are different types of noise which affects the image. Accordingly, image enhancement process for improving the quality of an image is needed then. After improving the quality of an image again restore that image. At present technology for fog removal are of two types-

- Fog correction
- Fog removal

The Fog correction is based on correction of contrast level. Color correction process is applied over HSV color space [2]. Color correction process generates transmission map and estimates atmospheric light resulting a defogging image. Further using color correction method enhanced video is created. Fog correction process improves the quality of foggy pixel but in fog removal process the fog level over an image is found out and removed [3]. Figure1. shows basic model for fog removal from images.

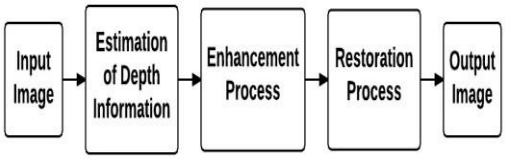

Figure1: Framework for Fog Removal

II. IMAGE ENHANCEMENT TECHNIQUES

Images and visual understandings are basis in everyday life and are very important tool for decision making. Images degraded by fog adversely affect the quality of vision-based physical security system. The resulting distortions from fog obscure contrast in image frames. So, there is the need of some image enhancement techniques to improve the quality of these pictures [5]. Image enhancement techniques can be divided into two parts: spatial domain and frequency domain.

The techniques of spatial domain can be further divided into point processing, spatial filtering, image subtraction and image averaging. Further Spatial filtering techniques are low pass, median and high pass filtering. The frequency domain is further divided into low pass filter, high pass filter, homo-morphing filter and pseudo color image processing. A pictorial representation of these techniques is shown in figure 2 is as given below:

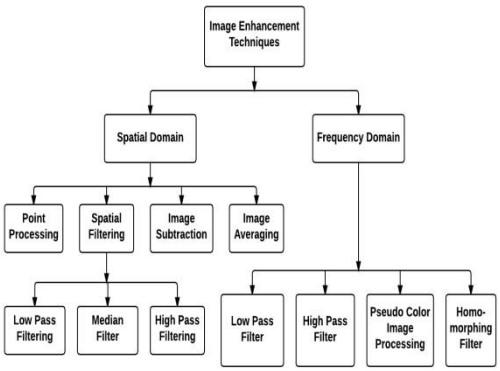

Figure 2: Classification of Enhancement Techniques

III. LITERATURE SURVEY

Negru et al. (2014) proposed an algorithm that was suitable for the image enhancement for the day time fog conditions. The fogginess turns the image processing applications slow and makes them sensitive. This proposed work is based on the mathematical model of the koshmieder's law for computing the atmospheric veil. In this paper, both the quantitative and qualitative evolutions are performed on both the real camera pictures and synthetic images. The main advantage of using this model is the ability to adapt as per fog conditions. This model is also applicable for both the grey scale and colored images. The main application of this algorithm is that it can be ported into mobile phones and provide the driving assistance as a low cost solution [6].

Jin Wu (2013) has given a review on the image defogging methods. Here, firstly image fogginess is detected and then different image restoration methods are applied to enhance the image quality. The models discussed by the author are global histogram equilibrium, local histogram equilibrium, image defogging based on multi-scale retinex and image defogging based on

guided filters are discussed. The results obtained from the different methods shows the guided filter algorithm as better defogging method [7].

Wang and Yang (2012) proposed a fast method for foggy image enhancement. This is a three step process. In this first step, the depth of the fogginess is extracted, in the second step transmission ratio of the atmospheric light is extracted and in the end gamma adjustment is used to get the final enhanced image. This method is compared with the retinex methods of deblurring and found to have the better results in the proposed algorithm [8].

Zhang et al. (2012) proposed a novel approach for the visibility enhancement using filtering approach. Here, it is considered that haze is due to outer layer of the noisy image part. The main reason for being this algorithm fast is that it is based on median filtering using a low-rank technique for visibility enhancement. Due to less computational complexity of low- rank techniques, the proposed algorithm is fast and can achieve the better & efficient results as compare to single image dehazing. The drawback of this algorithm is that it does not perform well in case of heavy and great depth fog [9].

Jeon et al. (2012) proposed an image enhancement method to enhance the contrast of the foggy images by estimating the relative depth of two images of same scene with time differences. The experimental results obtained from the proposed algorithm are satisfactory enough to remove the fogginess of the image [10].

Wilscy et al. (2008) demonstrated a novel method that not only improves the visibility but also maintained the color fidelity. This method consists of three phases. The first two phases are used to estimate a measure of degradation and its removal while the final phase used a novel wavelet fusion method to obtain the enhanced image [11].

Tan et al. (2007) developed a foggy image enhancement method based on color and intensity information. They were able to improve the visibility after estimating the color of skylight and the values of airlight [12].

IV. COMPARISON OF VARIOUS FOG REMOVAL TECHNIQUES

Nicolas Hautiere and Jean-Philippe tarel [13] proposed a method for estimation of visible edge in foggy image and visible edges of same image after contrast restoration process. Sobel gradient filter are used for finding the gradient of both images which use 3*3 window size filters over an image and find out the visible edges. This process is applied over contrast restored image at 5%. Nicolas proposed algorithm for finding out rate of new visible edges.

Figure 3: Original Image

Figure 4: Enhanced Image

In the equation above n_O and n_r are cardinal number of visible edges set in image (original image) and I_r (contrast restored image) Respectively and latter set is represent by Pr and calculate the r, which represent the quality of restoration by method Proposed by Nicolas[14].In below equation n_S is number of saturated pixels (black and white) which calculate contrast restoration and normalized the size value of image represent by in this equation given below:

$$\sigma = \frac{n_s}{dim_x * dim_y}$$

Figure 5: Visible Edges in Original Image

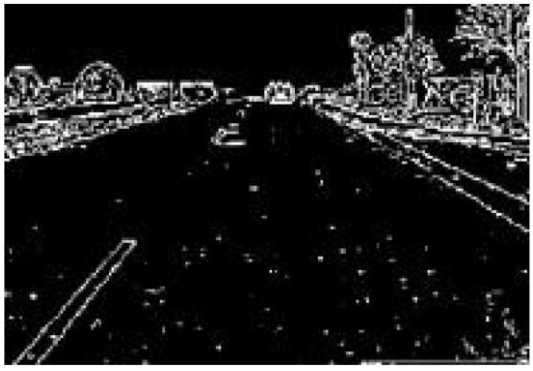

Figure 6: Visible edges in Enhanced Image

Inhye yoon, Seonyung kim and D. kim used adaptive defogging method in paper [1]. They present an algorithm for correction of color in HSV color space for defogging. For this process image is acquired by video then create a modified transmission map and estimate the atmospheric light for contrast enhancement and estimation process. After getting restored image we calculate the same quality parameter which calculates in paper [13] and fmd out the comparatively better result.

In paper [I] generate the transmission map then find out how much light reflect by object and reaches the camera. Consecutive frames are used for recovery of de- foggy frames.

Figure 7: Original Image

Figure 8: Enhanced Image

Visible edges rate is increase in methodology used by [1]. yoon paper because in this algorithm contrast restoration process is applied over each layer and pixel which produce the more visible edges as compare to previous method proposed by Nicolas Hautiere [13]. Quality of restoration which is denoted by r is also increased by 0. 2% compare then previous method n 5] So, the algorithm proposed by [1] in is better than algorithm proposed by [15].

Figure 9: Visible Edges in Original Image

Figure 10: Visible Edges in Enhanced Image

In paper [14] contrast enhancement techniques use the visible edges ration that compute for each pixel of visible objet and this algorithm applied only daytime fog image. In this approach each pixel having local contrast
5% only and process based on segmentation algorithm. Four descriptors are used for enhancements image-visibility level enhancement for each image before and after contrast enhancement. Estimate the rate of new visible edges.

V. CONCLUSIONS

In this paper, we have given the literature survey of various fog removal techniques. The different techniques of frequency domain based and spatial domain based algorithms are used for the enhancement of the algorithms. One is using synthetic foggy image as reference image to assess defogging algorithm. The other is computing the fog density for gray level image or constructing assessment system for color image from human visual perception to assess defogging algorithm without reference image. The results of different algorithms vary as per the input density of foggy image.

For Future reference, we can use the soft computing based techniques to enhance the quality of the foggy images because the traditional filters used for image enhancement are of not efficient success. Sometimes the image quality reduces with increase in light to image.

REFERENCES

I. Discussion and S. G. Narashiman and S. K. Nayar.Interactive deweathering of an image using physical model. In IEEE Workshop on Color and Photometric Methods In Computer VISIOn, October 2003.
II. N. Hauti'ere, .I.-P. Tarel, and D. Aubert. Towards fog-free in-vehicle vision systems through contrast restoration. In IEEE Conference on Computer Vision and Pattern Recognition (CVPR'07), pages 1-8, Minneapolis, Minnesota, USA,2007.
III. Gan Jian-Hong; He Tong-Li, "A Kind of Fog Visualization Methods in Three-Dimensional Geographic Information System," Informal/on SCience and Engineering (ISISE), 2010 International Symposium on , vol., no., pp.142,144,24-26 Dec. 2010
IV. K. He, J. Sun, and X. Tang. Single image haze removal using dark channel prior. In IEEE Conference on Computer Vision and Paltern Recognition (CVPR '09), pages 1956-1963,2009.
V. R. Tan. Visibility in bad weather from a single image. In IEEE Conference on Computer VISIOn and Palfern Recognition (CVPR '08), pages 1-8, 2008.
VI. Negru, M., Nedevschi, S., & Peter, R. I. (2014, October). Exponential image enhancement in daytime fog conditions. In *Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on* (pp. 1675-1681). IEEE.
VII. Wu, J. (2013). Research on Enhancement Technology on Degraded Image in Foggy Days.
VIII. Wang, R., & Yang, X. (2012, May). A fast method of foggy image enhancement. In *Measurement, Information and Control (MIC), 2012 International Conference on* (Vol. 2, pp. 883-887). IEEE.
IX. Zhang, Y. Q., Ding, Y., Xiao, J. S., Liu, J., & Guo, Z. (2012). Visibility enhancement using an image filtering approach. *EURASIP Journal on Advances in Signal Processing*, *2012*(1), 1-6.
X. Jeon, C., Park, D., & Ko, H. (2012). Fog-degraded Image Enhancement Using Two Images of Same Scene with Time Difference.
XI. Wilscy, M., & John, J. (2008). A novel wavelet fusion method for contrast correction and visibility enhancement of color images. In *Proceedings of the World Congress on Engineering* (Vol. 1, pp. 2-4).
XII. Tan, R. T., Pettersson, N., & Petersson, L. (2007, June). Visibility enhancement for roads with foggy or hazy scenes. In *Intelligent Vehicles Symposium, 2007 IEEE* (pp. 19-24). IEEE.
XIII. S.G. Narasimhan, and S.K. Nayar, "Contrast restoration of weather degraded images", IEEE transaction on pattern analysis and machine intelligence, Vol. 25, no. 6, pp. 713-24, June. 2013.
XIV. Z. Xu, et aI. , "Colour image enhancement by virtual histogram approach," IEEE Transactions on Consumer Electronics, vol. 56, pp. 704-712, 2010.
XV. Stark, lA. , "Adaptive image contrast enhancement using generalizations of histogram equalization," Image Processing. IEEE Transactions on, vol.9, no.5, pp.889,896, May 2000.

