Single Image Fog Removal Techniques Using Image Processing

Ankita Shrivastava[1], Dr. Manisha Sharma[2]

[1]*Dept. of Electronics Engineering, BIT, Durg, C.G., India*

[2]*Dept. of Electronics Engineering, BIT, Durg, C.G., India*

[1]*shrivastavaankita92@gmail.com*

Abstract

Fog is a big reason of road accidents, flight delays, late arrival of trains, etc. Contrast and color of the captured pictures are degraded under foggy weather conditions. To reduce the number of road accidents, an efficient fog removal technique plays a vital role as fog greatly reduces the visibility and hence affects the computer vision algorithms such as surveillance, tracking, etc. For improving the visibility level of an image and reducing fog, various image enhancement methods are used. In this paper, a novel and effective algorithm is proposed for single image fog removal that is capable of handling gray and color channels. This paper involves Image Restoration and Image Enhancement technique which will be used for restoring the clear image from a fog degraded image. Image enhancement is an area which deals with improving the quality measure of an image. Image restoration is an area that deals with improving the appearance of an image. The method involves estimation of depth of an image based on blur estimation. Measure of blur can be used for segmentation of an image in terms of depth. The advantage of the proposed algorithm is its capability to preserve sharp details whereas maintaining the color quality.

Keywords: *Contrast Enhancement, Image defogging, Image restoration, Image enhancement.*

1. Introduction

The images of outdoor scenes are usually degraded by the turbid medium (e.g., particles and water droplets) in the atmosphere. Haze, fog and smoke are such phenomena due to atmospheric absorption and scattering [7]. This occurrence influences the normal work of automatic (mechanized) monitoring system, outdoor recognition system and smart transportation system [8]. Light from the atmosphere and light reflected from an object are scattered by the water droplets, resulting the visibility of the scene to be degraded. The two fundamental phenomena that are consequence of scattering are 'attenuation' and 'airlight' [1]. By the usage of effective haze or fog removal of image, we can improve the stability and robustness of the visual system. Haze removal is a difficult task because fog depends on the unknown scene depth map information. Fog effect is the result of distance between camera and object. Hence

removal of fog requires the estimation of airlight map or depth map. The current haze removal method can be divided into two categories: (a) image enhancement and (b) image restoration. Enhancing the images acquired in poor weather conditions is called de-weathering and has been a very critical issue in applications such as aerial photography, driving assistance and visual surveillance. Restoration of images is important in several outdoor applications such as remote sensing,etc.[2].

2. Literature Survey

This section covers the literature survey from the study of various research papers. The literature survey describes various methods for improving foggy images. A brief description of various processes given by different authors is given below:

Anil Rai and Harpreet K. Bajaj (2017) proposed improved/hybrid fuzzy filter based haze removal algorithm. The dark channel prior can automatically extract the global atmospheric light and roughly eliminate the atmospheric veil. To make dark channel prior more effective, the atmospheric veil has been defined by using hybrid fuzzy filters as well as it is able to produce a haze free image in more optimistic manner. The use of improved/hybrid fuzzy filters has improved the coarse estimated atmospheric veil by reducing halo artifacts.

Arun Khosla and Md. Imtiyaz Anwar (2017) proposed a novel and effective algorithm for single image fog removal that is capable of handling images of gray and color channels. The proposed algorithm introduces Dark Channel Prior (DCP) followed by Weighted Least Square (WLS) and High Dynamic Range (HDR) based fog removal scheme. The qualitative and quantitative analysis is applied for the assessment of defogged images obtained from the proposed methodology and is additionally compared with the different fog removal algorithms to establish its superiority. The foremost dominant advantage of the proposed algorithm is its capability to preserve sharp details whereas maintaining the color quality.

Jun Mao et al (2014) found that the lowest and higher value in color channels tends to be the same value of atmospheric light based on the atmospheric scattering model analysis and the statistics of various outdoor images, for most foggy images. A function for estimating the haze degree is developed for the automatic detection of the foggy image with different haze degrees. The results show that the method can be applied to usual weather conditions in video-surveillance, driver assistance and optical remote sensing system with high accuracy.

Jyoti Sahu et al (2012) proposed an effective fog-free methodology to remove fog from input image. In this method, firstly, the original image is converted from RGB to YCbCr. Secondly, compute the intensity component of the YCbCr image and key observation of the all pixels of the image. Most local patches in fog-free outdoor images contain some pixels which have very low intensities in at least one color channel. Using this methodology with the fog image, the author can directly estimate the local white balancing of the image, global white balancing of the image, median of the image and mean of the image. After getting all above details, the author applied an original image and finally show the fog free image. The proposed algorithm of the article is an efficient and reliable choice for fog removing from the color image and also useful in hue preserving contrast enhancement of colored images.

Kshitiz Garg and Shree K. Nayar (2007) provided a comprehensive analysis of the visual effects of rain and the various factors that affect it. Based on this analysis, the author developed efficient algorithms for handling rain in computer vision as well as for photorealistic rendering of rain in computer graphics. First, a photometric model was developed that describes the intensities produced by individual rain streaks and then a dynamic model that captures the spatio-temporal properties of rain. Using these models, a simple and effective post-processing algorithm for detection and removal of rain from videos.

Munira A Jiwani and S. N. Dandare (2013) proposed defogging method from a single image based on depth estimation using blur. Estimation of depth information is under constraint problem if single image is available. Hence, removal of fog requires assumptions or prior information. Here, a method is proposed to estimate the depth of the image based on blur estimation. Measure of blur can be used for segmentation of image in terms of depth. For the better performance of the fog removal algorithm, contrast gain should be high and percentage of saturated pixels should be low at the same time.

Sheelu Mishra and Tripti Sharma (2014) uses image restoration and image enhancement technique for restoring clear image from a fog degraded image. Restoration techniques tend to be based on mathematical or probabilistic models of image degradation. To improve image quality, image enhancement can selectively enhance and restrain some information about image. It is a method which decreases image noise, eliminate artifacts and maintain details. The author proposed an integrated technique which will integrate the non linear enhancement technique with the gamma correction and dynamic restoration technique. The fine performance with increase in local contrast and overall sharpness, especially in scenes of poor visibility, make it one of the prime candidate for homeland security and safety duties.

3. Methodology

3.1 Block Diagram

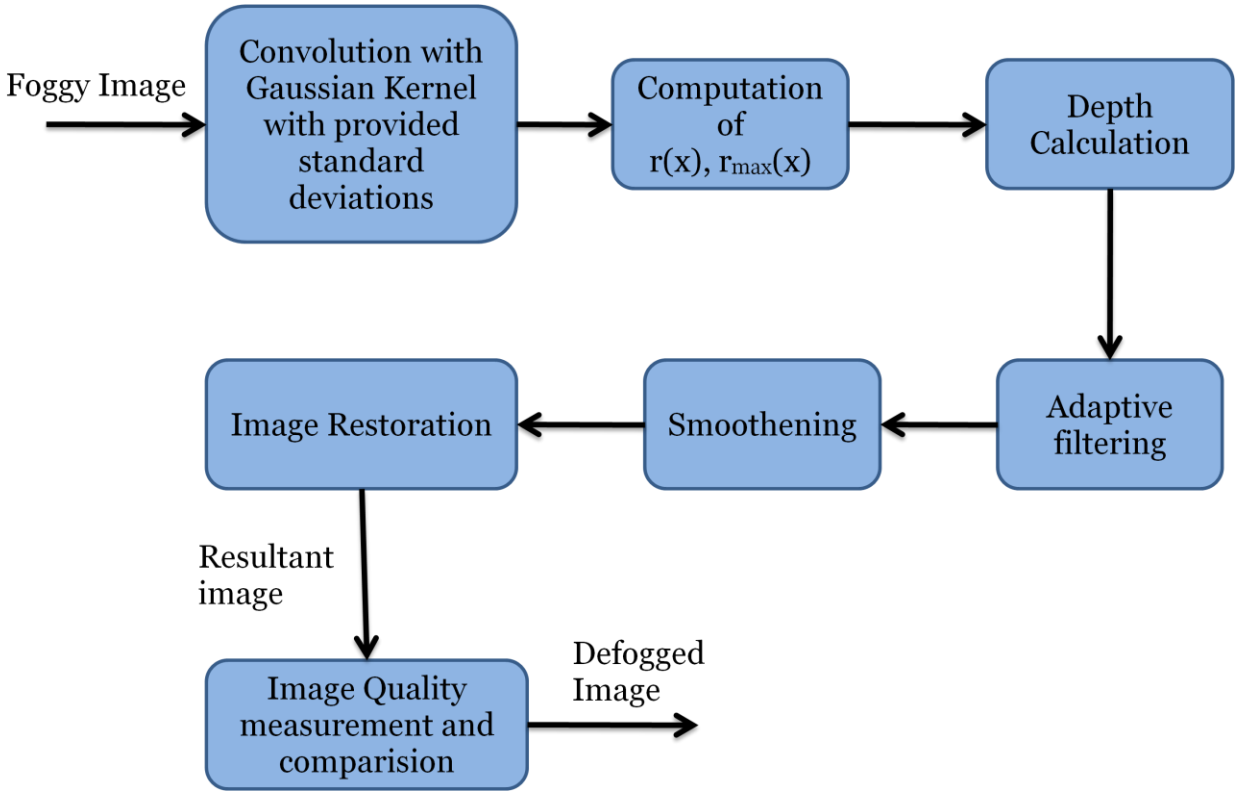

Fig 3.1 Block diagram of project

3.1 Working

Step 1:
Read the input color image.

Step 2:
Calculate the blur of image by Hu and Haan method.

1. Reblur signal which is to be determined twice with Gaussian kernels σa and σb.
2. Determine the local blur σ of the signal.
3. The signal is then convolved with a Gaussian kernel with different standard deviations leading to two signals.
4. To make local blur independent of amplitude and offset, ratio is computed.
5. Apply a maximum filter to calculate the maximum ratio.

Step 3:
Estimate the absolute depth of image with the help of estimated blur.

Step 4:
Apply depth on image.

Step 5:
Apply Adaptive Filtering.

Step 6:
Calculate the contrast, saturated pixels, number of edge pixels and PSNR of image.

4. Conclusion

Fog due to dust, smoke and other dry particles reduces visibility for distant regions by causing a distinctive gray hue in the captured images. Fog or Haze elimination is difficult because the fog is dependent on the indefinite depth information. Haze removal methods have become more useful for many computer vision applications. All the dehazing methods useful for surveillance, intelligent vehicles, for remote sensing and under water imaging, etc. Fog removal algorithms are used to improve the visual quality of an image, which is affected by light scattering through haze particles. This paper presents various simple and faster defogging methods used in the field of image processing techniques, through which fog can be estimated from the captured foggy images.

Acknowledgement

I would like to give my sincere gratitude to my guide Dr. Manisha Sharrna ma'm for her guidance and support for completion of this work.

References

4.1 Journal Article

1) Anil Rai and Harpreet K. Bajaj, "Improved Airlight Estimation Algorithm by using Fuzzy filters and Dark Channel with large haze gradients", International Journal Of Computer Applications (0975-8887), Volume 166-Number 4, 2017.
2) Arun Khosla and Md. Imtiyaz Anwar, "Vision Enhancement through single image fog removal", Elsevier, International Journal of Engineering Science and Technology (2017).
3) Jun Mao, Uthai Phommasak, Shinya Watanabe and Hiroyuki Shioya, "Detecting foggy images and estimating the Haze Degree factor", Journal of Computer Science Systems Biology, 7:6, 2014.
4) Jyoti Sahu, "Design a New Methodology for Removing Fog from the Image", International Journal of Advanced computer Research", Volume 2, Number 4, Issue 7, 2012.
5) Kshitiz Garg and Shree K. Nayar, "Vision And Rain", International Journal of Computer Vision 75(1), 3-27, 2007.
6) Munira A Jiwani and S. N. Dandare, "Single Image Fog Removal using Depth estimation based on Blur estimation", International Journal of Scientific and Research Publications, Volume 3, Issue 6, 2013.
7) Sheelu Mishra and Tripti Sharma, "Image Restoration Technique for Fog Degraded Image", International Journal of Computer Trends and Technology (IJCTT), Volume 18, Number 5, 2014.
8) Surabhi Deshpande, Shivali Pande, Saloni Dajjuka and Harshal Baheti, "Image Processing for Haze Removal", International Journal of Advance Research, Ideas and Innovations in Technology, Volume 3, Issue 2, 2017.

4.2 Books

9) Digital image processing by Rafael C. Gonzalez and Richards E.Woods.
10) Digital image processing using matlab by Rafael C. Gonzalez and Richards E. Woods and Eddins.