A Review on Image Restoring Techniques of Bad Weather Images

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ABSTRACT
This paper presents a review on the different techniques of restoring bad weather images. Due to bad weather like fog, rain, haze and snow the vision gets degraded. The techniques used in many applications such as outdoor surveillance, automatic monitoring system, outdoor recognition system, intelligent transportation system and object detection. The paper objective is to explore the techniques used to enhance visibility of bad weather images. Paper projects the limitations of the existing methods and proposes algorithm for enhancing visibility of such weather conditions.

Keywords
Restoration, Hazy, DCP.

1. INTRODUCTION
Outdoor scenes are often affected by fog, haze ,rain smog .User wants to capture a clearer picture .Poor visibility in the atmosphere is due to suspended particles. The incoming light from a scene or object is scattered due to these particles and hence is attenuated till it reaches the camera and due to this contrast and saturation of captured image reduces. To addresses the problem of the degradation in vision occur because of weather affected from fog, haze, rain and snow in an image and to have the better solution than the existing methods qualitatively and quantitatively. To design a method and to demonstrate its effectiveness over prior work on a number of examples using image processing techniques.

Visibility restoration implies the various methods that aim to remove the degradation that have been observed capturing the digital image. This degradation may be occurring due to numerous reasons like relative object-camera motion, blur due to camera mis focus, relative atmospheric turbulence and others.

Varied weather conditions such as fog, rain, haze or snow will cause versatile visual effects of spatial or temporal domains in images or videos and degrade the quality of outdoor vision system.

Rain is one of the major component types of dynamic bad weather condition. Rain produces sharp intensity variations in images, which demean the quality or performance of outdoor vision systems.

Haze image is an opaque medium like water droplets in the atmosphere, which will degrade outdoor vision images due to atmospheric absorption and scattering. Its removal is an extreme task as fog depends on upon the unidentified scene depth data. Foggy image is the function of distance amid object and camera. Foggy and Hazy image are components of steady weather.

Fig 1.Camera Foggy Image(Cloudy Image)

Fig 2.Camera Hazy Image (Dry Image)

Image restoration firstly studies the physical process of image imaging in foggy climate the performances of vision systems of outside images based on image/video feature extraction or visual concentration. Acquired images can be used in modelling as detection, of event ,object detection, tracking of events, and recognition, scene analysis, surveillance and classification, image indexing and retrieval.[2] This influences the typical working of automatic monitoring system, outdoor recognition system and intelligent transportation system. There are various visibility restoration techniques of removing fog and haze from bad images and have specific method for enhancement of images .Some of prominent methods are :

1. Dark Channel Prior (DCP)
This technique used for non-sky patches atleast one color channel has very low intensity at some pixels. We can also say that intensity of dark channel of haze image have higher intensity. We also apply pre and post processing steps for better results. The DCP steps involve:

a. Airlight Estimation
b. Transmission Map estimation
c. Transmission Map construction
d. Restoring of Image

2. Contrast Limited Adaptive Histogram Equalization (CLAHE)
It is a modified method of histogram equalization. Initially, in the CLAHE method the camera taken foggy image is captured and converted from RGB color space to HSI color space. RGB stands for red, green and blue space whereas HSI is Hue, saturation and intensity. The conversion is done because human eye to sense colors is similar to HSI space. Then intensity component is processed and this method use histogram equalization and finally the image is converted to RGB color space.

3. Weiner Filtering
This method is used with dark channel prior to make it more optimized problem of DCP .It addresses the problem of color distortion when the images having large white area.To estimate the media function median filtering ids used.

4. Bilateral filtering
In the bilateral filtering each pixel is replaced by weighted averages of its nearest neighbour's pixel.It smoothes images without effecting edges.The result using this filter is faster.In this we use histogram equalization as pre processing step where as histogram stretching as post processing step.It increase contrast of the image and is used for various navigation purposes in the dense fog also.

2. LITERATURE SURVEY

Depending on weather conditions the fog or haze removal is based on physical model.These are of two kinds out of which one is known as physical based model and non physical based model.Physical based model are based on atmosphere transmission model which analysze the factors affecting atmosphere that can effect the quality of the outdoor images that can be recovered by inversing the transmission process.In contrast non physical based models don't care that the process the image transmitting in atmosphere medium, they enhance image based on subjective visual feeling.Within these two models the ones based on physical model achieve great effect as the validity of physical model and assumptions used are highly researched. The methods of restoring foggy or hazy images specifying their limitations and outcomes is shown in the table:

Table 1. Methods of restoring foggy/hazy Images with their limitations and outcomes

Type of Image	Methodology Used	Outcome & Limitation	Reference
Foggy and Hazy Image	The method used transmission maps with multiple blocks and temporal filtering.	*****The proposed method is faster. ***** A challenge for HD and high quality previews or to have fog removal for heterogeneous platforms.	**[1]**
Hazy Image	A survey and trial analysis on Direct channel prior based methods.	Each step of the dehazing process help developing advanced dehazing algorithms.	[2]
Hazy image	The proposal of a novel linear color attenuation prior, based on the distinction in the clarity and the saturation of the pixels within the hazy image.	*****High efficiency and outstanding dehazing effects. *****Overcome the challenge of dehazing algorithms based on the atmospheric dispersing model are level to underestimating the transmission in some cases. more advanced physical models can be measured .	**[3]**
Hazy Image	A physical model based dehazed single image method and the brightness components of the image, adopting the MSRCR algorithm to estimate the transmission map is proposed.	*****The results are simple, fast, and can retain image details well. ***** Its shortcomings are that halos and excessive exposure tend to appear in the regions of slow change and bright areas of the image. This is a problem that we will address in future.	**[4]**
Hazy Image	A fast single image dehazing method with domain transformation-based edge-preserving filter and	Experimental results	[5]

	weighed quad tree subdivision is proposed.	verified that the proposed method is competent of removing haze effectively and obtaining images with vivid colour information. Specifically, it could be adopted in the real-time applications due to its computational efficiency.	
Hazy Image	proposes a novel approach based on Fisher's Linear Discriminant-based Dual Dark Channel Prior scheme for restoration of hazy images featuring realistic scenes captured in varied weather conditions. The constitution of the proposed system is composed of three unique stages: a localized light detection stage, an adaptable parameters generation stage, and a hazy image recovery stage.	The results of qualitative and quantitative evaluations using images captured during various weather conditions indicate that the proposed FLD-based DDCP approach achieves the most adequate restoration outcome without the generation of artifact effects when compared with the results produced through the other DCP-based approaches.	[6]
Hazy image	A novel real time haze removal algorithm based on the dark channel prior, with the help of down sampling and guided filter.	*****Method is much faster, implies that it is much appropriate mainly for avionic real time applications. *****The shortcoming of the method is that the method of up sampling is too easy, which would influence the contrast of output haze free image.	**[7]**
Foggy Image	A comparative review on prevailing approaches in this area through functioning of the methods observing parameters common for significant s analysis.	Many algorithms are developed for improving the visibility quality of an image in spatial domain but if these methods are applied in frequency domain then it produce better result and reduce the time.	[8]

3. FINDINGS AND DISCUSSION

Algorithms used for improving visibility of affected bad weather images are useful in vision applications. There are numerous algorithms designed but no single method is appropriate for enhancing visibility. There are the various research gaps identified during the literature survey:-

1. The existing methods had ignored the noise and illumination issue.
2. No method is correct for distinctive sort of circumstances.
3. No focus has given on the integrated approach of the dark channel prior (DCP) and CLAHE.
4. Many algorithms designed in spatial domain and based on basic physical model.
5. Existing algorithms developed for normal quality previews of images that does not bear heterogeneous platform.
6. For better results fuzzy based picture enhancement strategy can be used.
7. Algorithms designed using simple up sampling procedure.

4. CONCLUSION

Development of bad weather vision algorithms become more useful for many vision applications. It is found that most of the existing algorithms neglected the fact that no technique is accurate for different kind of integrated visions. This review reflects shortcomings in the existing algorithms as noise illumination, lack of integrated approach and most algorithms are designed in spatial domain. The algorithm needs to be developed which produces integrated approach for image restoring from various sources or can be applied to the image/video enhancement in future to enhance existing methods in such a manner that modified technique will show improvement. In near future to overcome the shortcomings a new integrated algorithm will be proposed using dark channel prior and with designing algorithms in frequency domain with improved up sampling procedure. The future scope of developing the algorithm using dark channel prior or DCP based image dehazing specifying and analysing its conventional steps like atmospheric light estimation, transmission map estimation ,transmission map refinement and finally image reconstruction would show better performance as compared to the existing algorithms of enhancing visibility.

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