# Comparative Analysis of Image Defogging with its Techniques and Types

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*Abstract*— Images play an important role in the real world, images are used for describing the changes in the environment and also use of traffic analysis. Images are captured in open environment due to the bed whether or atmosphere images are not a clear. Images acquired in the bad weather, such as the fog and haze, are extremely degraded by scatting of the atmosphere, which creates the image color gray, decreases the contrast and create the object features challenging to recognize. The bad weather not only lead to variant of the visual outcome of the image, but also to the difficulty of the post processing of the image, as well as the inconvenience of entirely types of the tools which rely on the optical imaging, such as satellite remote sensing method, aerial photo method, outdoor monitoring method and object identification method. There are some prior assumptions which need to be considered in removal of the fog. So basically fog removal algorithms work by estimating the depth. There are numerous applications of fog removal such as in the case of navigation and tracking, entertaining industries, and customer electronics.

***Key words:*** Component, Formatting, Style, Styling, Insert

## I. INTRODUCTION

At current, most optical remote sensing schemes, video-surveillance and driver-assistance have been planned to effort under decent weather and visibility situations. Poor visibility often happens in hazy or foggy weather environments and can powerfully influence the accuracy or even the common functionality of such image methods. Consequently, it is significant to import real weather-condition document to the suitable dispensation mode. Recently, significant development has been made in haze elimination from the single image [1,2]. Based on the hazy weather classification, specialized methods, such as a dehazing procedure, can be employed to progress of recognition. Figure 1 displays a sample dispensation flow of dehazing database. Despite its remarkable value, defining weather knowledge a single image has not been thoroughly the studied. Classical algorithms are designed for particular applications or want human intervention. Weather-recognition structures for automobiles, which depend on the vehicle-specific priors have been suggested [3-6]. Another suggested scheme [7] can automatically label images with greater confidence, by assigning weather labels, such as cloudy, or sunny; however, manual input constraints are necessary. Beside this background, the highest goal of the current learning is to progress a set of established algorithms for the noticing labeling the haze degree of images and foggy images by applying a factor with worldwide applications. In this paper, we suggest a haze degree approximation function to automatically distinguish label images and foggy images with their corresponding haze degrees. The atmospheric scattering model statistics and analysis derived from numerous outdoor images in order to progress the approximation function.

Fig. 1: Enhancement of image degraded by fog

## II. WHAT IS FOG?

### A. What is fog?

The official description of the fog is a visibility of less than 1,000 m. This boundary is applicable for aviation purposes, but for the common motorists and public an advanced limit of 200 m is more realistic. Severe disruption to the transport happens when the visibility falls below 50 m. Valuable labels for these three groups are aviation dense fog, fog and thick fog.

### B. What causes Fog?

Fog is caused by the little water droplets suspended in air. The thickest fogs tend to happen in manufacturing areas where there are numerous pollution particles on which water droplets can produce.

### C. Types of Fog:

Fogs which are composed mainly or entirely of water droplets are commonly categorized according to the physical procedure which produces near-saturation or saturation of the air. The main kinds of the fog are:

*1) Mixing or Evaporation Fog:*

This kind of the fog forms when enough water vapor is added to the air of the moist and evaporation air mixes with cooler, comparatively drier air. The two general kinds are frontal fog and steam fog. Steam fog forms when cold air changes over the hot water. When the mixes the cool air with warm, humid air over the water, humid air cools, till its moistness fog forms fog forms 100% and reaches. This kind of the fog takes on the arrival of the wisps of smoke increasing off the surface of the water. The other kind of the evaporation fog is called as frontal fog. This kind of fog forms when warm raindrops vaporize into a cooler, drier layer of air close to the ground. Once sufficient rain has vaporized into the layer of the cooler surface, the moisture of this air reaches 100% and fog forms.

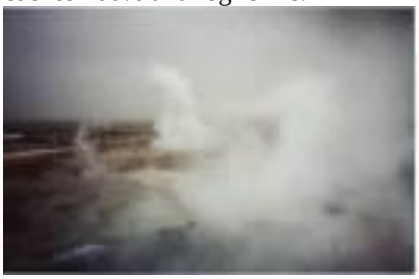

Fig. 2: Image of Evaporation or Mixing Fog

 

*2) Radiation Fog:*

This kind of the fog forms at night below clear skies with the calm winds when warmth absorbed by the surface of earth's throughout the day radiates into the space. As the surface of earth's continues to cool, providing a deep sufficient layer of moist air exists near the ground, the moisture will reach 100% and also fog will form. Radioactivity fog also varies with the depth from 3 feet to the about the 1,000 feet and is continually finding at ground level and commonly remains stationary. This kind of fog can decrease visibility to near zero at times and create driving very hazardous. Valley fog is a kind of radiation fog that is very general in mountain of the eastern Kentucky. When air along ridge tops and the higher slopes of mountains begins to cool after the sunset, air becomes heavy and dense and begins to drain down into valley floors below. As the air in valley floor continues to cool because of the additional cooling, the air becomes fog and saturated forms. Valley fog can be very thick at times and create driving very hazardous due to the reduced visibility. This kind of fog tends to the dissipate very rapidly once the sun comes up and also starts to vaporize the fog layer.

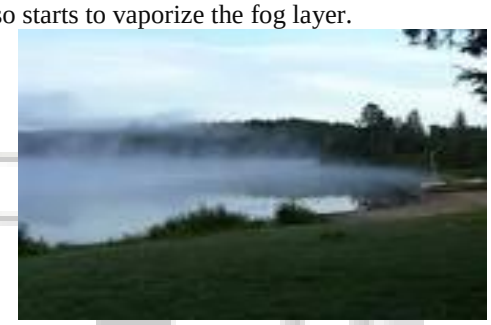

Fig. 3: Image of Radiation Fog

*3) Upslope Fog:*

Upslope fog forms when the light winds push humid air up a slope or hillside to a level where the air becomes condensation and saturated happens. This kind of fog generally forms a good space from the peak of the mountain or hill and covers a large area. Upslope fog happens in each range of mountain in North America. This generally happens at the time of months of the winter, when cold air after a cold front drifts encounter and westward the eastward fronting slopes of the Rocky Mounts. As the moist, cold air increases up the slopes of the mountains, condensation happens and extensive areas in fog form on the minor slopes of the mountains. This kind of fog forms when the temperature of the air is well lower freezing and is composed entirely crystals of little ice that are suspended in the air. Fog of ice will only be witnessed in the cold Polar/Arctic air. Normally the temperature will be the 14 F or colder in the order for the ice fog to happen. [14]

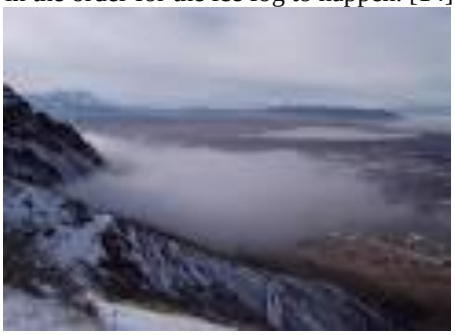

Fig. 4: Image of Upslope Fog

## III. VISIBILITY RESTORATION TECHNIQUE

For removing haze, fog, mist from the image various techniques are used. Typical methods of image restoration to the fog are:

### *A. Dark Channel Prior*

Dark channel prior [10] is an effective image prior. It was proposed to expel cloudiness from a single image, where the key perception is that most local patches in outside fog free pictures hold a few pixels whose intensity is low in no less than one shade channel. In light of this former with the fog optical model, one can specifically assess the thickness of the dimness and restore a great fog free picture. Then, the dark channel prior was also employed in [8,9] for single image dehazing. This procedure is for the most part utilized for non-sky patches, as no less than one shade channel has low intensity of a few pixels. The low intensity oblivious channel is prevalently due to three segments:-colorful things or surfaces (green grass, tree, blossoms, etc.), shadows (shadows of auto, structures and so forth), dim things or surfaces (dark tree trunk, stone).

As the outdoor images are usually full of shadows and colorful, the dark channels of these images will be really dark. Due to fog (airlight), a hazy image is brighter than its image without haze [13]. So we can say dim channel of haze image will have higher intensity in areas with higher haze. In this way, visually the intensity of dull channel is a harsh, close estimation of the thickness of cloudiness. In dark channel prior we likewise utilize pre and post processing steps for showing signs of improvement results. In post processing steps we utilize soft matting or bilateral filtering, etc. Let J (x) is the input image, I(x) is foggy image, and t (x) is the transmission of the medium. The attenuation of image due to fog can be expressed as:

$$I_{att}(x) = j(x)f(x) \dots\dots\dots\dots (1)$$

The effect of fog is Airlight effect and it is expressed as:

$$I_{air\ light}(x) = A\big(1 - t(x)\big) \dots\dots\dots\dots\dots (2)$$

Dark channel for an arbitrary image J, expressed as J dark is defined as:

$$j^{dark}(x) = \frac{min}{y \in \Omega}(\min j^{c}(y)) \dots\dots\dots\dots\dots\dots (3)$$

In this Jc is a color image involving RGB segments, represents a local patch which has its origin at x. The low intensity of dark channels is credited for the most part because of shadows in pictures, saturated color items and dark objects in images.

### *B. CLAHE (Contrast limited adaptive histogram equalization)*

The CLAHE method [10] applies histogram equalization to sub-images. Every pixel of the original image is at the focal point of the sub- image. The first histogram of the sub-image is cut and the cut pixels are redistributed to each gray level. The new histogram is not quite the same as the first histogram on the grounds that the intensity of every pixel is constrained to a client determined maximum. Consequently, CLAHE can lessen the enhancement of noise.

### *C. Wiener Filtering*

Wiener filtering is based on dark channel prior: Wiener filtering [11] is used to counter the problems such as color

 

distortion while utilizing dark channel prior the estimation of media function is rough which make a halo effect in the final image. Thus, median filtering is utilized to estimate the media function, so edges might be preserved. In the wake of making the median function more correct it is combined with wiener filtering so the image restoration problem is converted into optimization problem. Blurring is because of straight movement in a photo is the consequence of poor sampling. Every pixel in a digital representation of the photo ought to signify the intensity of the single stationary point in front of camera. If the shutter speed is excessively moderate and the camera is in movement, a given pixel will be an amalgam of intensities from a point along the line of the camera movement. This is a two-dimensional analogy.

$$G(u,v) = F(u,v).H(u,v)$$

Where H is the blurring function, F is the Fourier transform of the "ideal" form of the image which is given. In this case H is the sinc function: if three pixels in a line hold info from the similar point on the an image, digital image will be seem to the have convolved with the three-point boxcar in the time domain. Idyllically, one of the could reverse-engineer an estimate, or Fest, if H and G are known. This method is inverse filtering.

### *D. Bilateral Filtering*

This filtering [12] smoothes images without affecting edges, by means of a nonlinear combination of nearby image values. In this, filter replaces every pixel by a weighted average of its neighbor's pixel. The weight assigned out to each one neighbor pixel diminishes with both the distance in the image plane and the distance on the intensity axis. This filter helps us to get come about quicker as contrast with other. While utilizing bilateral filter we utilize pre-processing and post transforming steps for better comes about. Histogram equalization is utilized as preprocessing and histogram stretching as a post preparing. These both steps help to build the contrast of an image previously, then after the fact utilization of the two-sided channel. This algorithm is independent of density of fog so can also be applied to the images taken in dense fog. It doesn't require user intervention. It has a wide application in navigation and tracking, entertainment industries and customer electronics.

## IV. LITERATURE VIEW

Jun Mao (2014) et al present that Partial visibility in haze weather powerfully influences the common functions and the correctness of almost driver assistance methods or outdoor video surveillance. The actual weather situation is valuable knowledge to invoke corresponding methods. Based on atmospheric scattering model, study and the statistics of the numerous outdoor images, for most foggy images, we discover that the highest and lowest value in the color channels tends to be the similar value of atmospheric light. A function for approximating the haze degree is established for the automatic discovery of foggy images with different haze degrees. Experimental outcomes display that our haze classification technique attains great presentation. [15]

Rita Spinneker (2014) et al present that number of cars is increasing, the driver is supported by the ADAS (Advanced Driver Assistance Systems). In specific camera based Advanced Driver Assistance Systems are a key component for the further enhancements in driving safety and comfort. While imaging sensors are executing well under good weather environments, their effectiveness suffers under adversative environmental influences such as heavy fog, snow or rain. To handle such optical threats and to the approximation knowledge feature of the cameras in any order to warn the assistance method of probable serious working situations, a self-diagnosis mechanism is of greater significance for the reliable operation of an optical Advanced Driver Assistance Systems. In this paper a method of the camera based detection of fog as part of the self-diagnosis mechanism for the Advanced Driver Assistance Systems based on the effect of blurring in fog is obtainable. The encouraging results of experiments have shown that the obtainable method of examining the PSS (power spectrum slope) of a minor image block in close to the proximity vanishing point permits a fast discrimination of street scenes without and with any fog. [16]

Richter, J et al present that The airflow into a room greatly affects temperature comfort inside. To attest the function of an air conditioning system that distributes air into a room, it is necessary to state important properties of the distributed air, as for example its location and shape. Therefore, the air is visualized by fog or other means. Consequently, its images are taken and are then evaluated. The images are edited and processed in the way of detecting information using mathematic methods, leading to a description and confirmation of the functions of the distribution system.[17]

Ruchika Sharma (2014) et al present that This paper presents a review of the different haze removal techniques. Haze brings trouble to many computer vision/graphics applications as it diminishes the visibility of the scene. Haze is formed due to the two fundamental phenomena that are attenuated and the air light. Attenuation reduces the contrast and air, light increases the whiteness in the scene. Haze removal techniques recover the color and contrast of the scene. These techniques are widely used in many applications such as outdoor surveillance, object detection, consumer electronics, etc. The overall objective of this paper is to explore the various methods for efficiently removing the haze from digital images. This paper ends up with the shortcomings of the existing methods. [18]

Manpreet Kaur Saggu (2015) et al present that the review paper, he has obtained and compared a study of numerous haze / fog elimination techniques / algorithms for image processing. Numerous algorithms are suggested so far for effective fog elimination. The dark channel prior based on fog elimination has provided quite promising results over the obtainable methods. Many researchers have also suggested numerous developments in the dark channel priorities so far to get improved outcomes. The combined trilateral filter based method has shown more significant outcomes over the obtainable methods. The general objective of this review paper is to explore the shortcomings of the previously presented methods used in the revolutionary era of image processing applications. [19]

Chirag Dhanani (2014) et al present that Now, a Day Images play important role in the real world, images are used for describing the changes in the environment and also use of traffic analysis. Both images are captured in open environment due to the bed whether or atmosphere images

 

are not a clear. Therefore main aim of this paper is to focus on the problem of several blurred, foggy and noisy low-resolution image convert into a high-resolution image. This paper proposes an efficient and increasing the quality of images from different foggy or blurred images by using super-resolution technique. This proposed technique has been found more effective than other existing technique in the terms of quality and clarity. In this work we have compared the results of various image enhancement techniques on different grounds like on the images of a building, high trees and open area, which are very important aspects of traffic analysis during foggy weather. This work has given an effective and fast foggy image enhancement, better visibility into image or video in real world images. [20]

## V. CONCLUSION

In foggy weather conditions, images become degraded because of the occurrence of air light. This is generated by scattering of light by fog particles. Here proposed an effective technique to the correct degraded image by the subtracting the estimated air, light map from the degraded image. The air, light map is generated using multiple linear regressions, which models the relationship between regional air, light and the coordinates of the image pixels. Air light can then be estimated applying a cost function that is based on human visual model, where a human is more unmoved to the differences of luminance in bright regions than in dark regions. When designing ventilation or air conditioning systems, it is necessary to find out the way how air is distributed into the room. For these purposes, the air is visualized (example. g. By fog) to take its images, which are consequently evaluated. One of the most important features contained in the image is the location and shape of the airflow. This information is obtained by detecting border curves of the fog.

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