ISSN No:-2456-2165

Fog Contrast Restoration using Image Processing

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Abstract:- Current image processing application captures degraded contrast with error prone images in fog condition Single-Image algorithms used for fog condition of daytime. It is bases on mathematical model to compute atmospheric veil by considering the variation in fog density with distance. Objects at greater distance are not visible in fog. Density of Fog is low and has characteristic of nonlinear increase with distance. Quantifiable and approximate calculations are done on Images. By using this process, it is feasible for reconstruction of fog-free image. And it proves that the mathematical model is one solution for contrast rebuilding in homogeneous or heterogeneous conditions.

Keywords:- *Fog, Image enhancement, Weather conditions, Image contrast, Image processing.*

I. INTRODUCTION

Image processing approach are used almost every application fields. Images are used in different applications like Traffic systems , Map navigation , lane identification, satellite imagery and military systems etc. For images used in these applications it's essential for the images to fetch true information of the scene. There are numerous occurrence due to which veracious information cannot be extracted from the image. These occurrences can be mainly seen as light source related, camera related, and weather related. Collectively these are introduced as optical threat. Optical threats because of light origins are due to of reflections, diffractions, scattering of light. Camera related optical threats are due to of misalignment of camera with scene, wrong calibration, movement of object or camera at the time of capturing, shaking of camera and blurring of images. Snow, heavy rain, mist, haze, fog Weather related optical threats are responsible for dwindle visibility. All the optical threats decrease the safety in daily life as vision plays an vital role. Mirage and additional lighting are examples of light related optical threats. Camera shake and less distinct images inhibit the image processing.

Different algorithms are available for the categorizing of fog and correction of colors also removal of blur due to fog. Contrast of the image residue an key part for predicting the visual quality and features in an image. Robust complexion of Image processing made its existence in almost every field. To utilize this image, it is mandatory these should provide true information. Misalignment of camera on the vehicles on which it is situated degrades the performance of the Advanced Driving Assistance Systems (ADAS). Rains and snow mixed with dust on the windshield can create smudge making it difficult for the drivers to see.

Contrast is an important character of images that means the range between the brightest grey level and the lowest grey level. Unfavorable weather conditions like fogs alter the contrast of outdoor images due to atmospheric particle scattering, which evolves different methods for contrast restoration of images. Contrast restoration is an important aspect for the restoration of original images for which the algorithms are developed in very recent past. Two broad categories of the contrast enhancement technique are modeling and non modeling methods.

Fog removal and correction are two different parts. Fog removal technique calculates the depth input of an image and enhancement of the depth calculated image is done. The enhanced images are restored with colors. In fog correction method, the images are translated to the HSV color space to get transmission map by applying color correction algorithms.

II. LITERATURE SURVEY

As technology proceed, image processing is extensively used in several applications in daily life. Thus, it is dominant for the obtained image to provide the correct information. The external images capture under adverse weather conditions tend to be degraded making them unsuitable for use in applications..Many algorithms have been proposed for the categorizing of fog ,correction of colors and removal of blur due to fog. Contrast of the image plays key role part for portraying the visual quality and details in an image. Image Processing intensify taken images from various applications like cameras or sensors placed on aircrafts, space or pictures taken. The output can be an actual physical image or the attribute of an image. Most of the techniques are broadly used for image enhancement taken from different applications. Examples similar to military flights, unmanned air spacecrafts, space probes. Now days availability of powerful computers, large size memory devices, graphics and softwares etc is easy. It is resulting in popularity increase of Image Processing.

Image processing techniques enable the organizing of image for using it in specific applications. Image analysis is process involves making significant calculations from existing image to get a quality content of the image received from applications. Image segmentation process that classifies an image into its segments of frames/ parts. The altitude of subdivision is dependent on the depth of problem, i.e., the segmentation level is built up on the isolation level of object interest in an application e.g., to get vehicle details from space and suppose intension lies in identification of vehicles on a road. In first step, need to segment the road. Second step to segment the contents of the road down to potential vehicles. Image processing based applications

takes the images in real time and produce the precautionary measure either in the form of warning to the driver or giving the information to next application to take measures for precautions. Image sensors perform well in normal weather conditions. The environmental conditions like rain, snowfall, fog reduces the image quality and visibility. Scattering phenomenon is the main cause for the fog effects are:

- *Attenuation*

Koshmieder's Law

The attenuation of luminance through the atmosphere studied by Koshmieder in 1924 and proposed a alliance between the attenuation of an object's luminance Lat distance d and the luminance Lo close to the object:

$$L = L_0 \cdot e^{-\beta d} + L_\infty \cdot (1 - e^{-\beta d})$$

- *Air-light*

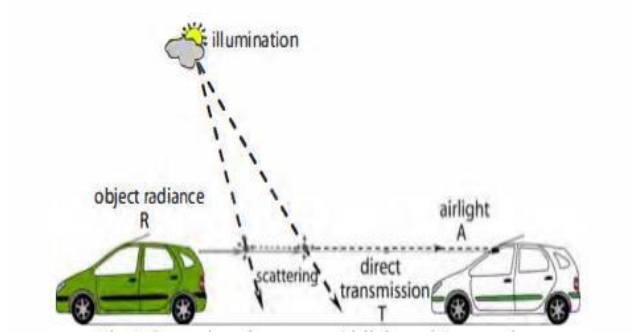

Fig 1:- Scattering phenomena, Attenuation and Air-light.

Figure1. shows how scattering effect is caused and its effect in everyday driving scenario. The effect of scattering is on the perceived object luminance. Fog mixed with light reduces the natural radiance of the object. An additional whiteness is also introduced due to presence of fog. The light beam gets attenuated and decreases the light contrast of the scene. Air-light ie a scattered light coming from source towards camera causes shift in color .The fog effect is the based on the distance between scene point and viewer or camera. Fog reduces visibility and contrast level of an image. So it is necessary to remove effects of fog on images. Two types of fog removal Techniques are Fog Correction, Fog Removal. Contrast level correction evaluates fog correction. HSV color space uses color correction process. It also process transmission map and estimates atmospheric light which results a defogging image.

Color correction is used to enhance video. Fog correction process upgrade the quality of foggy pixel and fog removal process the fog level over an image out removes it.

For Removal of In image Processing involves 4 steps : 1) Image Acquisition Involves the image frames captured by using CMOS/CCD sensors and cameras .2) Estimation process involves the air light, attenuation, depth map, Dark prior factor calculation for Enhancement. 3) Enhancement: The algorithmic calculations by using above factor to improve contrast and quality. 4) Restoration is a process to create fog free image after the enhancement

Contrast is calculated by using difference in the color and brightness of the object and other objects within the view. Contrast is of two types. The variance between darkest and lightest part in image is called as "Tonal" Contrast. The second category is "color contrast". color contrast is focused on characteristics of color, and the way different colors can either enhance/low one another.

III. PROPOSED SYSTEM

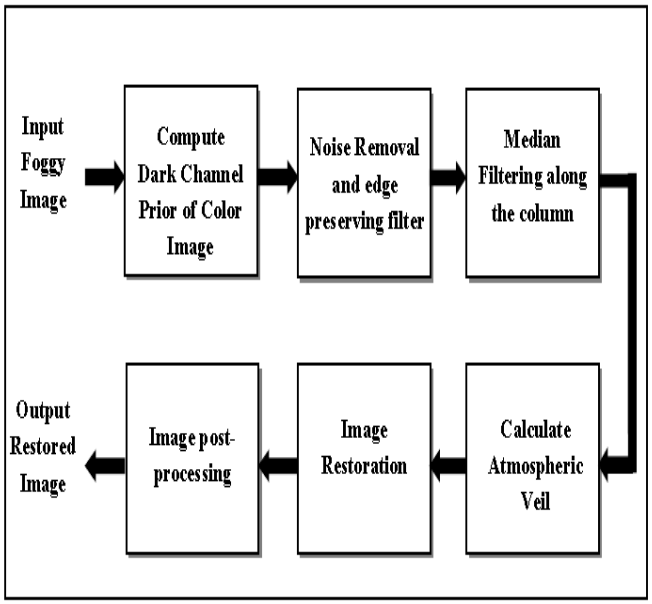

Fig 2:- Block diagram of fog contrast restoration using image processing

The proposed work deals with finding the atmospheric veil by different methods in MATLAB. A mathematical exponential function is proposed considering the increasing density of fog with the increase in distance from the camera. The obtained veil image is then multiplied with the exponential function to get the final output image. The reconstructed image is restored to have the natural colors of the image. Image post processing is done for tone mapping of the original and reconstructed image. Koschmieder's Law is studied to propose relation between intrinsic and luminance of the object in presence of fog. And it Involves below Steps:-

- Compute Dark Channel prior (Atmospheric veil) : A gray level image W is used :

$$W = \begin{cases} \min(R, G, B), & \text{for color images} \\ I, & \text{for monochrome images.} \end{cases}$$

- Noise Removal and Edge Preserving: A median Filter is used For preserving edges and Noise from input images:

$M = mediank(W)$

- Median Filtering Along the Column: As fog is more on top and tends to disappear at bottom, this method is used.
- Calculate Atmospheric Veil, exponential filter is used for final veil calculation.
- Image Restoration: Exponential Function used for restoration.
- Image Post processing. To Enhance the color channel to restore it to natural output.

The emphasis is to implement mathematical model for images to calculate atmospheric veil and contrast restoration by considering exponential decay of fog. The six methods for improve foggy images are as follows:-

1. No Black Pixel Constraint (NBPC)
2. No Black Pixel Constraint Planer Assumptions (NBPC PA)
3. No Black Pixel Constraint with squared exponential functions (NBPC + *fs*)
4. No Black Pixel Constraints with modulus exponential functions (NBPC + *fm*)
5. No Black Pixel Constraints with squared exponential function (NBPC + Gs)
6. No Black Pixel Constraints with modulus exponential function (NBPC + Gm)

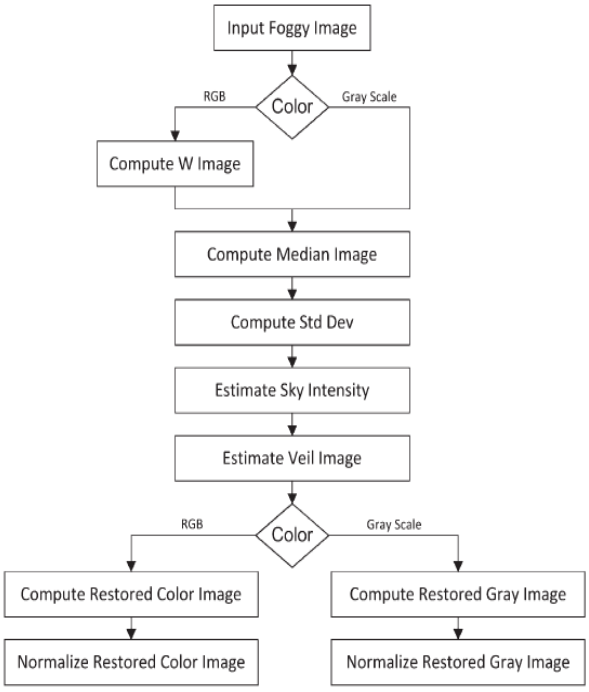

Fig 3:- General architecture of image enhancement system

IV. RESULTS

The foggy image taken as input is either a color image or grey image. The basic idea is to enhance the contrast of an image degraded by fog to improve visibility. For this purpose the atmospheric veil is taken as the key parameter to improve image quality. The images from FRIDA1 FRIDA2 dataset are used as input images for implementation of the six algorithms that are NBPC, NBPC PA, NBPC + *fs* , NBPC + *fm*, NBPC+Gs , NBPC +Gm.

Image Output for six algorithm for real world input foggy Image.

(a)
Fig (a):- Foggy image

(b)
Fig (b):- The output for NBPC.

(c)
Fig (c):- The output for NBPC PA.

(d)
Fig (d):- The output for NBPC+ *f s.*

(e)

Fig (e):- The output of NBPC + *fm*

(f)

Fig (f):- The output for NBPC + Gs

(g)

Fig (g):- The output for NBPC + Gm

V. CONCLUSION

The method with increased speed is feasible in real time processing and it is a robust method for removing fog and increasing contrast For this modulus exponential functions and squared exponential functions are translated and proposed. The translated exponential functions used for enhancing contrasts give better results than the previous methods for contrast enhancement. The value of parameter *a* is varied in the exponential and translated exponential functions. Using very less value of *a* (*a*=1) partitions the image into two parts. The bottom part becomes lighter. The value of *a*= 3.5 gives results better than *a*=1 but the difference in top and bottom part of the image can still be seen. Using the value *a*=7 gives best result out of the three different values of *a*. Subjective analysis using output images and variation in parameter *a* as well as objective analysis of SAD metric using all six algorithms for all four cases of fog results that the exponential and translated exponential functions perform best of all implemented algorithms.

VI. ACKNOWLEGMENT

The authors would like to thank the faculty of Dept of E&TC, MITCOE, Pune for their support and providing their valuable help. Also we would like to thank lab staff for their help in MATLAB software.

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