IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

MODIFIED DARK CHANNEL PRIOR

Modified DCP for Dehazing

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Abstract: The image captured by camera is degraded by various atmospheric parameters for example rain, storm, wind, haze, snow. The removing haze is called dehazing, is naturally done in the physical degradation model, which requires a solution of an ill-posed inverse problem. In this paper we will discuss and do the comparative study of Adaptive Histogram Equalization (AHE), Contrast limited adaptive histogram equalization (CLAHE) and dark channel prior (modified DCP). This article suggest image and video image defogging algorithm working on dark channel prior technique. The modified DCP is derived from the characteristic of natural outdoor images that the intensity value of at least one color channel within a local window is close to zero. The modified DCP system has good haze elimination and color managing potential for the images with various angles of haze. The dehazing is done through four major steps: atmospheric light estimation, transmission map estimation, transmission map refinement, and image reconstruction. This four step solution of modified DCP will give solution to ill-posed inverse problem. This dehazing techniques can be used in advanced driverless assisted systems in autonomous cars, satellite imaging, underwater imaging etc

***Index Terms* - Computer vision, Image processing, Image restoration, Image Enhancement, Video dehazing, Histogram Equalization, Dark channel prior**

I. INTRODUCTION

Because of the light scattered due to atmospheric elements, the degree of excellence of outdoor images taken in hazy weather conditions may be degraded severely [1]. Since degree of excellence loses its quality is related with loss of contrast and colour enhancement products that function consequently with the degraded images may not work appropriately; such products comprises of multimedia systems, automotive vision technologies, surveillance methods, and so on. Hence, to attain good recognition of this type of consumer products, the fog in the input image should be removed in order to improve the degree of excellence of the image. The signal processing employed to eliminate haze is called dehazing [12].

In video surveillance system, the characteristic feature of images is disturbed by the bad weather as like fog, haze and smoke. The efficient defogging technique can increase the functioning of the visual model. So, haze elimination is a challenging issue in computer vision method. The present defogging technique can be separated into two types: one is dependent on the physical type and the other is depend on non-physical type [14].

II. Survey of Dehazing Methods

The technique depend on physical system uses the atmospheric scattering system to restore the image by getting inverse process of image makes to lose its quality, whereas the technique depend on non-physical type don't test physical reason of image losing its quality produced by the weather parameters, it is a subjective process and aims at improving image degree of excellence according to the visual perception [16]. Generally the technique depend on physical type is efficient than non-physical type on the effect of haze elimination. The trending concept of haze removal technique is the technique depend on physical type in recent years [2], [19].

Technique depend on the dark channel prior (modified DCP) is simple, but it do efficient dehazing. The modified DCP-depend dehazing technique shows impressive dehazing degree of excellence when compared to other previous methods [3].

Fewer quantity of research only has been completed in image processing of un-degree of excellence images associated with the other image processing branches. IE is primarily increasing the image degree of excellence without any loss of information. Enhancement methods are product specific and accordingly, for a particular product, certain features that are needed to be focused are enhanced[4].

Alternatively, the video saliency type gets less attention compared to the images, but it has obtained good consideration nowadays. Distinct from image saliency identification, motion data offers a strong prior [5].

Since night time image had its light not mono-colour (traffic lights), and was not like daytime image having sunlight regularly glowing on, the area with colour light irradiation did not shield the whole picture, and may be one or several neighbouring areas [6]. In this article, we present a real-time night video enhancement approach using an improved dark channel prior type depend on atmospheric scattering type [7]. Iteratively extract Transmission under the theory that large-scale chromaticity changes are due to Transmission while small-scale luminance changes [8].

In this article section II is related work, section III describes the methodologies, section IV is about Experimental Result, section V describes the comparison of various methods and section VI concludes the survey work. Previously popularly utilized technique are as following:

1. AHE - Adaptive Histogram Equalization
2. CLAHE- Contrast limited adaptive histogram equalization
3. Modified DCP- Modified Dark Chanel Prior

1. AHE

Adaptive Histogram Equalization Method (AHE) Adaptive Histogram equalization technique is a modified part of histogram equalization technique. In this technique enhancement process are applied over a specific region of any image and adjust contrast according to their neighbour pixels. AHE for Enhancement in HSV colour space. 'adapthisteq' function utilized in MATLAB for equalization of intensity according to neighbour pixels. This technique is utilized only for homogeneous fog correction, Dynamic range separation Histogram equalization (DRSHE) technique for enhancement. In this technique histogram separated into some predefined sections. Then alter the brightness of that region and regularly share into gray scale image. The main drawbacks of AHE technique is the potential to over-amplify noise in comparatively homogeneous areas of an image [10].

2. CLAHE

Contrast limited adaptive equalization is a customized concept of adaptive histogram equalization. Augmentation function is executed on the entire neighbourhood pixels and transformation process is extracted in this method. This varies from AHE because of its restriction in contrast. CLAHE technique for improvement process, in this technique utilized greatest value to cut the histogram and reorganize in gray level image. Algorithm implemented individually for background and foreground and restrict the noise, improve the contrast. Distribution factors are utilized for shape of histogram equalization graph, 'Rayleigh' distribution factors are utilized for bell shaped histogram. CLAHE executed over two varieties of images namely gray scale and coloured. 'Clip limit' function are utilized for apply limit over a noise image. Colour space is utilized for RGB true colour images. The main drawback is CLAHE functions on tiny data regions (tiles), instead on the whole image. It is computationally more cost. It is quite complicated in hardware[10].

3. Modified Dark Channel Prior

Modified DCP (Dark Channel Prior) technique is utilized for the enhancement of video quality**.** MODIFIED DCP was proposed in recent times and has obtained a huge acceptance. The modified DCP is extracted from the feature of normal outdoor images that the brightness value of at least one color channel inside a local window is near to zero. Based on the modified DCP, the dehazing is carried out using four key stages: atmospheric light calculation, Transmission map calculation, Transmission map modification, and image restoration. This four-stage dehazing function makes it feasible to offer a stage-by-stage method to the complicated solution of the ill-posed inverse issue [15]. This also provides us to get rid of light on the regular assistance of modern researches associated to the modified DCP for all stages of the dehazing function. Our broad review and experimental testings on modified DCP-related techniques will assist readers recognize the efficiency of the single stage of the dehazing function and will smooth the progress of growth of superior dehazing algorithms [2].

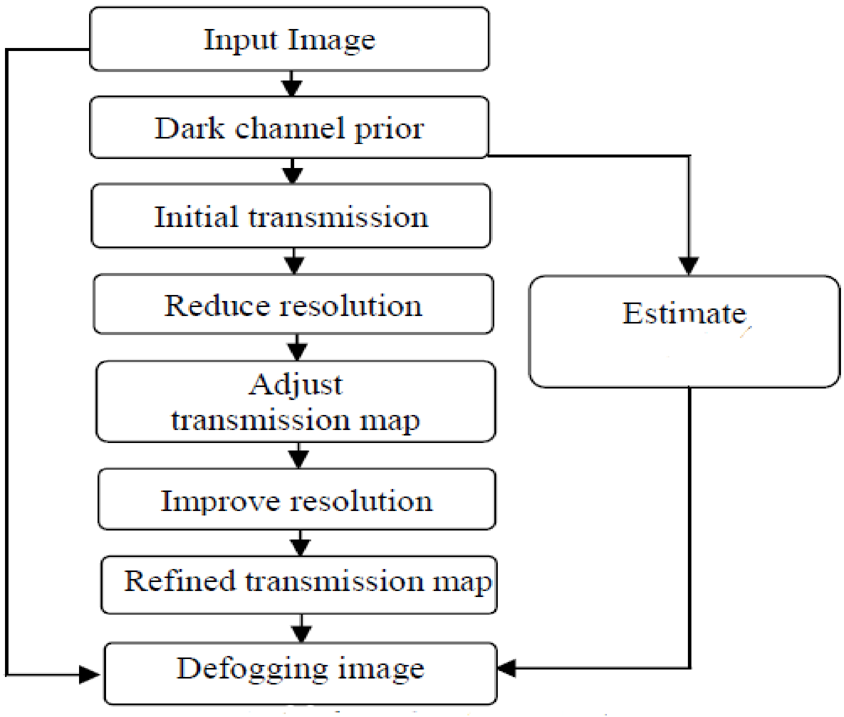


Figure 1. Image Enhancement Using modified DCP

In certain fog images, which has more of sky regions or huge bright regions, the image accepted the technique of dark channel prior defogging will emerge as color deformation. This happens because the dark channel value on these regions is hard to near to zero, even supposing with no fog. So the theory of dark channel prior is not appropriate for these regions. Additionally, in order to increase the functioning rate of algorithm, the concept of multi-resolution is utilized to reduce the pixel intensities of early Transmission rate map. Subsequently, the technique is tuned to reduce calculation time. The flow chart of the algorithm is displayed as figure 1.

The haze model, which describes the degradation of atmospheric visibility, is a good approximation for a wide range of weather conditions and several situations. However, it misrepresents the perceived scenes and causes therefore undesirable results on dehazed images at high densities of fog. Haze model as shown in Figure 1 (a).

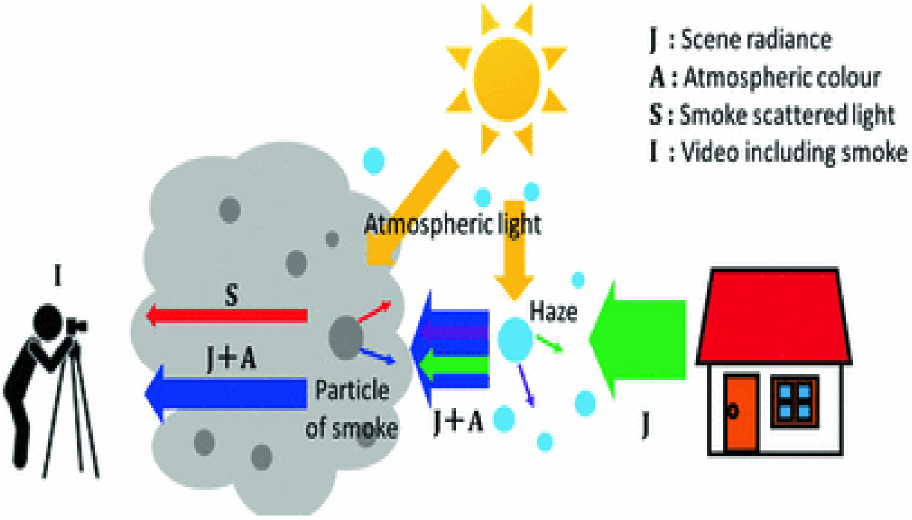


Figure 1(a) Haze Model

equation(1) to achieve the following simpler image formation model

$$I(x) = t(x)J(x) + (1-t(x))\,A \quad (1)$$

This model (1) explains the loss of contrasts due to haze as the result of averaging the image with a constant color A. If we measure the contrasts in the image as the magnitude of its gradient field, a scene J seen through a uniform medium with $t(x) = t < 1$ gives us

$$\|\nabla I\| = \|t\nabla J(x) + (1-t)\nabla A\| = t\|\nabla J(x)\| < \|\nabla J(x)\| \quad (2)$$

IV. EXPERIMENTAL RESULT

Figure 2. Original input image

A set of images defogging effect, consists of the technique depending on the dark channel prior and the recent updated technique. Figure 2 shows the original input image. Temporarily, it provides the initial Transmission map and the Transmission map developed by the multi-resolution.

Figure 3 displays their corresponding dark channel images.

Figure 3.Dark Channel prior

As displayed in Figure 4, color deviation occurs in the dealing of the brightness area through dark channel prior algorithm, specifically in the sky area which has abnormal color spreading beyond its border. But from Figure 6 it is found that the improved algorithm can overcome this problem.

Figure 4. Initial Transmission

The color of the defogged image obtained by the suggested algorithm is more normal, and very reliable with the original. When introducing the tolerance method, the entire brightness of the image can be increased. Meanwhile, joined with multi-resolution ideas, the proposed algorithm can decrease the computational costs and can convince the speed demands for video image defogging[6].

Figure 5 .Refined Transmission map

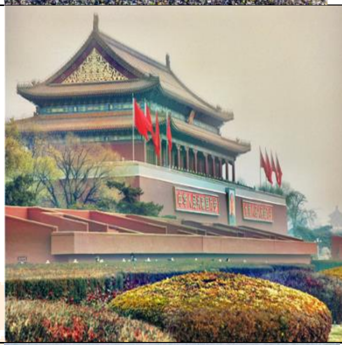
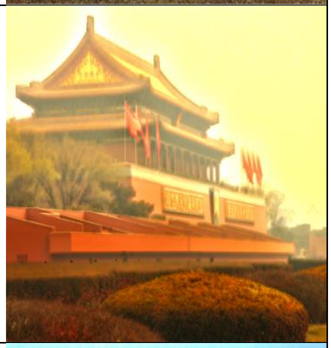
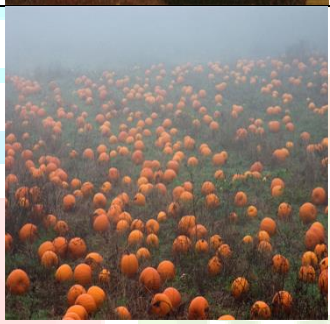
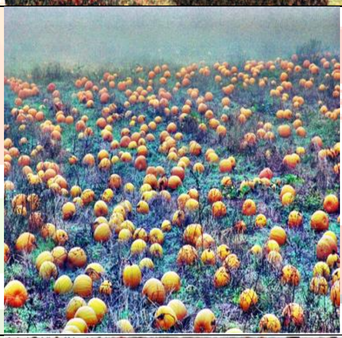
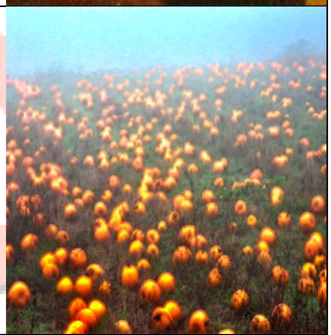
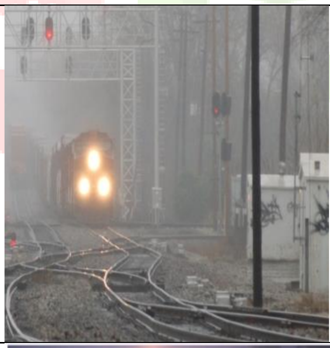
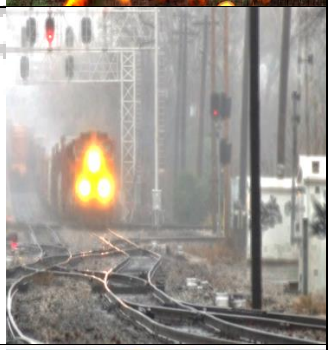
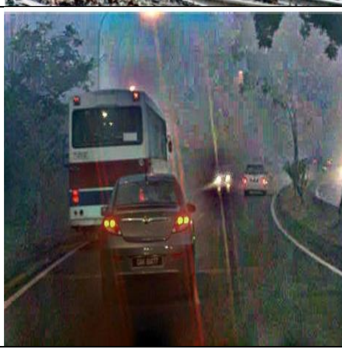
The initial Transmission is denoted in figure 4 and Figure 5 indicates the refined Transmission map , Figure 6 is the final Defogged image

Figure 6. Defogged image

V. METHOD COMPARISON

Comparison of existing and proposed system image after applying modified DCP algorithms for image enhancement. Table 1 is the original Input Image by camera in night time. an Previous model for enhanced result before using CLAHE, and the image colors, as had an effect by shine and chromatic deviation, are observed to be badly damaged, for CLAHE, enhanced result. considers the region disturbed by shine, so that shine is not made improved, but blocking manmade objects are enormously clear in its improved result, and present method is an improved result after applying the modified modified DCP technique of this paper, in which the issue of preventing manmade objects is enhanced, building the image rebuild to be further normal[9]. The method comparison using different types of images used. The Data set is HMDB51 using the process. Compare the existing and proposed system. and calculate the PSNR(Peak signal to noise ratio), MSE(Mean Square Error), Entropy (Energy of the image), Correlation(similarity measure) are shown in Table 2 and Figure 7(a-d).

Table 1. Method Comparisons

IMAGES NAME	INPUT IMAGE	CLAHE IMAGE	Modified MODIFIED DCP IMAGE
FOREST			
FORT			
PUMPKIN			
TRAIN			
VEHICLE			

1.PSNR:Peak signal-to-noise ratio is an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation as shown in Figure 7 (a). Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale in Equation (3).

$$PSNR = 10.Log_{10}.\left(\frac{MAX_I^2}{MSE}\right) \quad (3)$$

MAX_I^2- maximum square value of pixel in the image

Table 2. Output Parameters Comparisons

Parameters	PSNR		MSE		ENTROPY		CORRELATION	
Image name	**CLAHE**	**MODIFIED DCP**	**CLAHE**	**MODIFIED DCP**	**CLAHE**	**MODIFIED DCP**	**CLAHE**	**MODIFIED DCP**
Forest	15.481	68.67	4.5e+03	1.4e+03	6.52	6.83	0.82	0.98
Fort	19.762	69.9	4.9e+03	1.2e+03	6.11	6.72	0.8	0.962
Pumpkin	19.4	69	4.23e+03	1.42e+03	6.02	6.99	0.832	0.941
Train	18.9	61.2	4.76e+03	1.39e+03	5.92	6.86	0.813	0.927
Vehicle	16.92	68.9	4.40e+03	1.1e+03	6.06	6.78	0.847	0.948

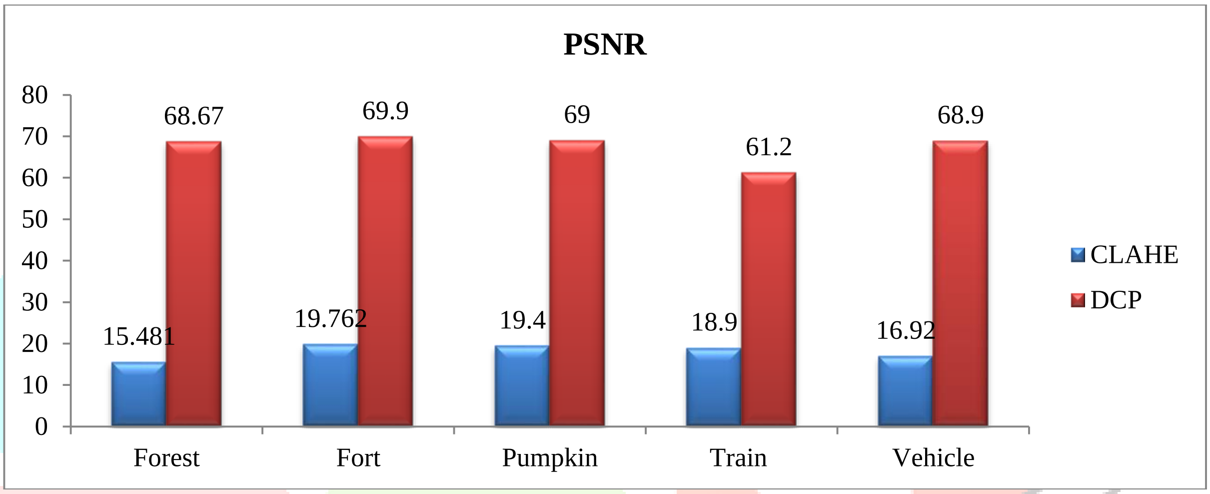


Figure 7(a). PSNR

2.MSE: Mean squared error measures the average of the squares of the errors. the average squared different between the Observed values and the actual value. MSE is a risk function, corresponding to the expected value of the squared error loss as shown in figure 7 (b). The fact that MSE is almost always strictly positive is because of randomness or because the Calculating does not account for information that could produce a more accurate estimate in Equation(4).

$$MSE = \frac{1}{MN}\sum_{n=1}^{M}.\sum_{m=1}^{N}.[INPUT - OUTPUT)]^2 \quad (4)$$

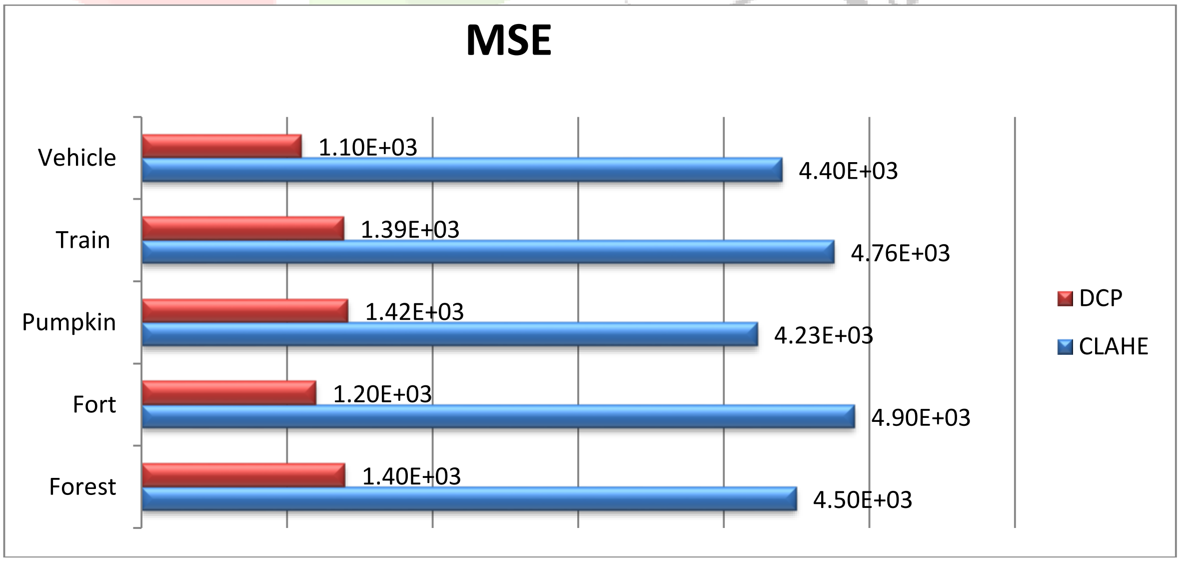


Figure 7(b). MSE

3.Corrrelation: Figure 7 (c) is The correlation coefficient that indicates the strength of the relationship between two images(input and output) can be found in Equation (5),

$$r_{XY} = \frac{\sum(X-X_i)(Y-Y_i)}{\sqrt{\sum(X-Xi)^2(Y-Yi)^2}} \quad (5)$$

r_{XY} - Correlation
X-Image Row Pixel , Y- image Column pixel
X,Y- Input
Xi, Yi- output Image

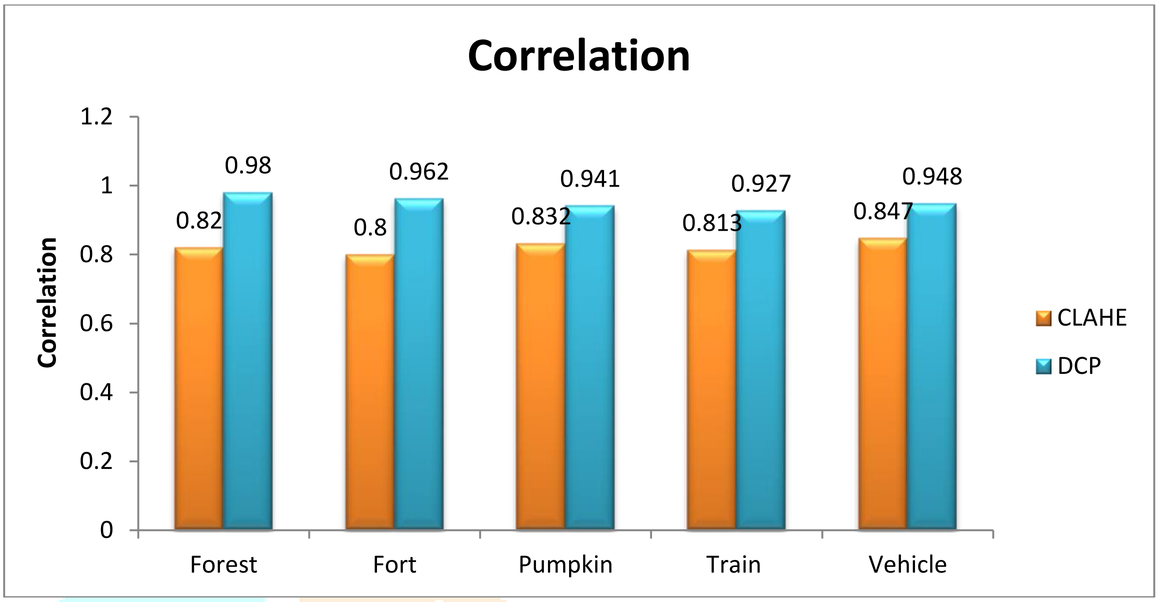


Figure 7(c) Correlation

4.Entropy: Figure 7 (d) is statistical measure of randomness that can be used to characterize the texture of the input image. Equation (6) is given by

$$\textbf{Entropy} = \sum (p.*\log_2(p)) \quad \textbf{(6)}$$

p - Counts normalized histogram

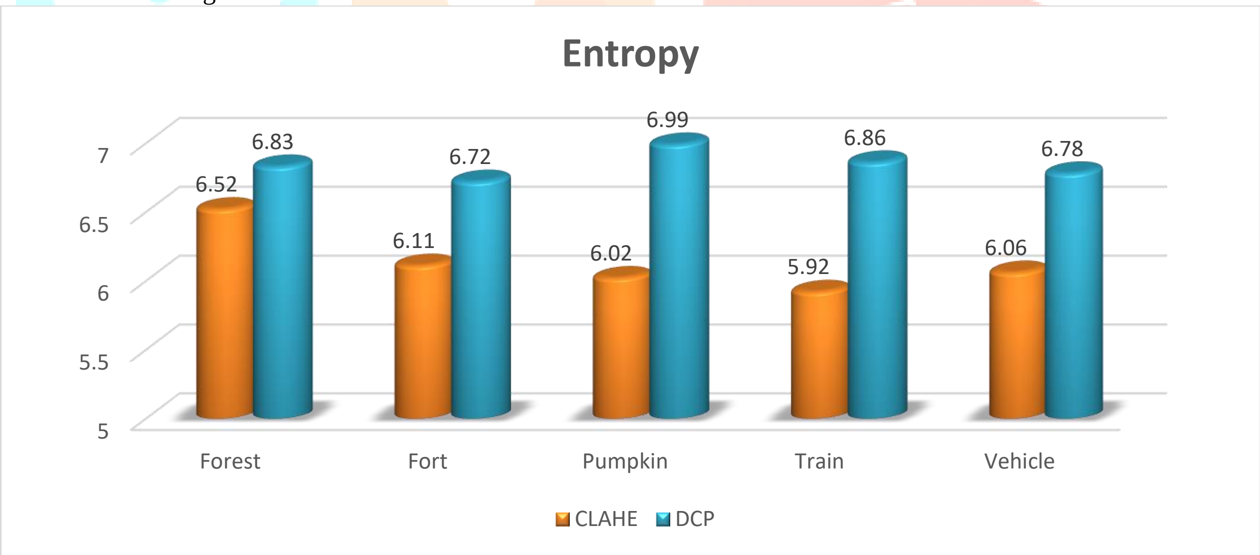


Figure 7(d). Entropy

VI. CONCLUSION

This article described effective systems to understand a fast dehazing system targeting outdoor video streams. The original modified DCP-depend dehazing technique was improved in order to make the dehazing functions in a rapid manner meanwhile sustaining a dehazing degree of excellence. Nowadays, people have more requirement of surveillance device. Data's show that illegal actions and traffic accidents generally occurs in the night time with poor observability. This image enhancement technique improves the night time image degree of excellence. Concentrating on the dark regions of night time image with exceedingly reduced visibility, there is even important development consequence. The quality of the video is improved a lot and the values of PSNR and MSE are found as high.

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