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Modified IDCP Technique for Accurate Image Defogging

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Abstract

Digital Image is an imperative part in the explanation and analysis of data, which is in the digital type. Images and videos of outside scenes are generally affected by the bad weather environment such as haze, fog, mist etc. So image has bad visibility of the scene caused by the lack of quality. In current scenario the defogging techniques are not used practically in real time systems such as cases of train accidents due to fog. This paper exhibits a study about various image defogging techniques to eject the haze from the fog images caught in true world to recuperate a fast and enhanced nature of fog free images. The paper also presents a novel modified IDCP technique for efficient image defogging. In proposed work, we enhance digital images by applying modified technique model i.e. M-IDCP (Modified-Improved Dark Channel Prior) Technique which provide a superior quality picture with clear visibility and distinctive color. Toward the end, we remove the first defogging image and look at them based on their Peak Signal Noise Ratio (PSNR), Mean Square Error (MSE) parameters. Result obtained from modified model (IDCP- DCP- HE-CHAHE) showed improved performance in term of estimation of air-light , sky regions become bright and smoother and halo effect is also reduced in robustness PSNR and MSE than that of (DCP- HE-CHAHE) in addition to the quality of recovered defogged image. With this proposed work defogging parameters as PSNR and SNR have been increased by more than 20 percentage as compared to other literature.

Index Terms**:** *Image Defog; DCP; IDCP; CLAHE; PSNR; MSE*

INTRODUCTION

Image processing (IP) systems increment the estimation of a picture from the defiled picture. Outdoor scene images captured in the bad weather are often offended because of the entity of the haze, fog, mist, or other media. And other bad environment by such as fog, haze, rain and snow is the main reason of image degradation which have poor quality. During Fog, The light gets spread out before reaching the camera, when we take an image using a camera due to a little impurity in the atmosphere .So study on image defogging is very necessary for IP and target recognition. Image enhancement technique enhances the opposite of haze image but it lead to loss of information in image. Image Restoration (IR) deals to the physical method of images in fog. Picture will be set in the debasement of haze and cloudiness. At last, the corruption method is utilized to make the fog-free image. [1][3]

In mostly systems, related to image visibility degradation [7] can be hard which run under a wide range of environment conditions, including outdoor object recognition systems, remote sensing systems, smart transportation systems such as recording of travelling vehicle data and traffic observation system [11]. By the presence of floating small particles in the atmosphere, haze is produced which is called aerosols. This is able to grasp and spread the beams of light. Immediately in digital vision, image dehazing has turn out to be a major research problem. The

preparing of picture which is foggy is fairly troublesome. [12].

Most of the work on defogging have been done but there is a lack of visibility in defogging image and have poor contrast. Due to this degradation of image, proposed methodology introduced new technique i.e. M-IDCP for to modify more actuate defogging image and modify image color and contrast. This proposed Defogging technique provides more actuate visibility of image for use in defogging application such as Traffic monitoring, video surveillance, Video security, and Marine surveillance.

Old researchers uses the traditional techniques from a single image, IP is Tan's work, is founded on two observations. In the first place, cloudiness free pictures have more complexity than pictures corrupted by terrible climate; Second, the varieties of air light, which relies upon the separation between the items to the watcher. As of late, numerous examinations have arranged on single picture way to deal with re-establish the perceivability of a foggy picture. These procedures depend on either solid suspicion or hearty priors, by which fog thickness is likely by utilizing just a solitary picture. A fog free picture has clear stands out look at from a foggy picture. Utilizing of assessment of variety of scene differentiate, this technique reestablishes the deceivability of a picture by boosting its neighborhood differentiate [1]. The substance of this paper is sorted out.

The main segment of this work presents the presentation of title. The second area of this work presents defogging based paper and utilize defogging proposed systems. The third area of this work presented proposed work Methodology. The fourth segment of this work presented the proposed result and Last area of this work conclude this paper.

Fig: 1. *Original Image and Fog Removal Image*

LITERATURE SURVEY

The various earlier defogging techniques used are as following:

Zhigang Ling et al.[2017] [2] has proposed a novel image defogging methodology by specifically predicting the haze thickness of recovered images as opposed to receiving earlier constraints . So as to accomplish this objective, two particular steps are presented. To start with, we embrace three fog relevant features got from foggy images, and further build up a simple fog density evaluator (SFDE) by making a linear merge of these fog-relevant features. This proposed evaluator can proficiently see the fog density of a single image without reference to a relating fog-free image and has a low

computational load compared to other method. Second, a physics-based numerical relationship between the transmission and the mist thickness score of the reconstructed picture is shaped by methods for SFDE; hence picture defogging can be act like a minimization issue on the mist thickness score of the reconstructed picture.

Changli Lii et al.[2017] [3] this article mostly focus of the image restoration. First of all, it studies the He's defogging algorithm based on DCP and make some improvement based on this theory. Aiming at solving the defects of inaccurate estimation of full of atmosphere light and long time running of He's algorithm, the improvement of estimation of climatic light and transmittance are introduce in this paper. To improve the transmittance of estimation by introducing a gain coefficient instead of soft matting algorithm for long time. At the similar time four binary tree subdivision methods is in the habit of estimate the atmospheric light, which is able to shorten the operation time, avoid the halo phenomenon and get an improved defogging outcome.

Md. Imtiyaz Anwar et al [2017] [4] has projected an image improvement through haze evacuate utilizing a single gray or a color image, by post-processing method. This algorithm is based on DCP concept followed by a post-processing method based visibility enhancement scheme for foggy images. Quantitative methodology is applied for assessment of defogged images obtained from the proposed methodology and it is also have differentiate from other certainly understood techniques to establish its efficiency. The proposed algorithm preserves sharp details and maintains the color value of the defogged image [4].

Jaiveer Singh Sikarwar et al. [2016] [5] this has been appeared in existing exploration that the big part of the present systems has numerous issues. To overcome the imperatives of the previous work; a novel framework has been existing in this paper. In this examination, modified dark channel prior (MDCP) and Gaussian Laplacian filtering (GLP) with transmission delineate.

The proposed work is actualized in MATLAB utilizing image dispensation toolbox. The comparison among l0 normalization technique and the planned algorithm is measured different types of performance, namely, the peak signal noise ratio (PSNR), entropy and execution time. The experimental results have composed of dissimilar types of fog image and it has shown better results as compared to previous methods.

Xin Ning, et al. [2015] [6] planned an image fog elimination system. This strategy in view of the disinhibition properties of retinal neurons concentric open field whose capacity is three Gaussians. Firstly by using CLAHE we enhance mist picture. Secondly, to re-establish the images details and deepness information a local image improvement method is passed out. According to experiment, the results of this paper's method were compare with the results of DCP based method and the results of CLAHE. The new results it was able to avoid enhancing too light and to avoid adding noising it has proved that the method of CLAHE. The method of this paper worked well in images fog removing and enhanced fog images' visibility.

The next section deals the techniques which are used in this work to build the novel defogging technique.

Defogging techniques used

The Defogging techniques used in proposed methodology are as follows:

Dark Channel Prior

This technique is really useful for defogging of single image. This fog free method is mostly used for non-sky patches. Fog-free image obtained in minimal intensity of color channel at few pixels due to three components: colorful things, shadow and black things. These pixels are called as dark pixels [7]. These dark pixels are used for fog-free image by the transmission map.

After DCP applied pre and post-processing or some specified filter for retrieving the good result. Basically, the minimum intensity in such a bit to have very lowest value.

Dark channel revealed in eq:(1) is intended by:

$$K_{dark}(z) = \min\{min_{yep(z)}(L_c(\mathrm{x}))\} \quad (1)$$

Where
L_c is a color channel of K,
p(z) is a local patch and it take patch size of 15*15 ,
I(x, y) is foggy image.

IMPROVED DARK CHANNEL PRIOR (IDCP)

IDCP was proposed by Yan Wang, Bo Wu in the year 2010. Same concept as used by DCP but at same time provides improvement for estimation of air-light by increasing the patch size to 31 × 31.Time complication reduces, and also it avoids making use of soft matting technique or pre and post –processing .[8].

CONTRAST LIMITED ADAPTIVE HISTOGRAM EQUALIZATION (CLAHE)

CLAHE (Xu, Zhiyuan et al, 2009). CLAHE is used for developing of bad distinction image. This strategy does not need any predicted climate data for the preparing of fog image. Initially, the image captured by the camera in foggy condition is distorted more than from RGB (red, green and blue) shading space is changed over to HSV (hue, saturation and value) color space. The images are changed that the human sense color same as HSV represent colors.

AHE has capability to overestimate the noise amplification which is prevented by CLAHE. CLAHE limit the magnification by setting the limit called clip edge [9].

HISTOGRAM EQUALIZATION (HE)

Histogram equalization (HE) is a system utilized for altering the image intensities to expand the distinction of an image.

Let g is an image with the pixel intensity lying [0 to L-1] where L is the gray values of the image.

Let q represents the normalize histogram of g shown in eq: (2). Therefore

$$q_n = \frac{T_n}{T_P} \quad (2)$$

Where Tn is the no of pixels with gray values of n and Tp is the totality number of pixels where value of n lies in the range of 0 to L-1.

The histogram stable image is defined shown in eq: (3) by [10]

$$hist_{eq} = \text{floor}((\text{L-1})\textstyle\sum_{n=0}^{g(i,j)} q_n) \quad (3)$$

PROPOSED METHOLOGY

Initially, Proposed work selects foggy image from dataset folder use in MATLAB toolbox [5] (city-1, city-2, Tree images). Foggy image passes various technique methodology. i.e. (DCP-HE-CLAHE) that will effectively solve insufficient fog evaluation and color reconstruction. Thusly, an astounding picture with clear perceivability and distinctive shading can be created.

In our propose work, we upgrade our

image by concerning new method i.e. M-IDCP (Modified Dark channel prior) which provide improvement for remove air-light by increasing the patch size to 31*31 and increasing an edge preservation. In proposed work, Image shows more clarity and decrease halo effect.

PROPOSED ALGORITHM

INPUT: foggy image
OUTPUT: fog free image
STEP 1: Browse a foggy image from dataset.
STEP 2: Select Dark Channel Prior procedure
STEP 3: Then, Select Histogram equalization.
STEP 4: Concern CLAHE (Contrast limited Adaptive Histogram Equalization).
STEP 5: Then, IDCP (Improved Dark Prior Channel).
STEP 6: Compute proposed approach result in a term of PSNR (Peak Signal to Noise Ratio) and MSE (Mean Square Error).

Following parameters used in proposed work to compare the result:

MSE (Mean Square Error)

If comparison of two images is made based on their respective qualities then a metrics called MSE is used. The MSE between two images g(x,y) and f(x,y) shown in eq: (4) is

$$e_{MSE} = \frac{1}{LN}\sum_{n=1}^{L}\sum_{l=1}^{N}[f(n,l) - g(n,l)]^2 \qquad (4)$$

Where L is the number of rows and N is the number of columns correspondingly.

PSNR (Peak Signal to Noise Ratio)

One of the issues with the MSE, the PSNR in eq: (5) keeps away from (MSE depends intensely on the picture force scaling) by scaling MSE as per the picture extend.

$$\text{PSNR} = -10\log_{10}\frac{e_{MSE}}{Q^2} \qquad (5)$$

Where Q is the maximum pixel value.

At first, Proposed work has been chosen foggy image appeared in (fig.4) from dataset. DCP (Dark Channel Prior) Model technique has been applied on foggy image. With this model technique, some area of image has been fog-free means some fog in image has been eliminated as appeared in (fig.5). However, image is still not clear because DCP output image has low percentage edge preservation and consider only 0.1% dark channel of input image. After DCP, different systems have been connected i.e. HE(Histogram equalization), by this technique fog and haze has been removed from large surroundings and have low contrast image shown in (fig.6) but with this technique, image still have bad contrast picture . Then apply CLAHE technique (Contrast limited Adaptive Histogram Equalization) on output of HE technique image. This system changed RGB (red, green and blue) color to HSI (hue, saturation and intensity) color in image in shown in (fig.7). With CLAHE system, Overall picture is significantly brighter and looks like an unreal image. Now solve this insufficient fog evaluation and color contrast problems by present proposed modified technique. On Apply new modified technique M-IDCP shown in (fig.8) (Improved Dark Prior Channel) on CLAHE output image, edge preservation increases, sky regions become bright and smoother and it's provide improvement for remove air-light by increasing the patch size to 31*31. By this modified IDCP technique enhance more accurate fog free image which have high quality image with clear visibility and vivid color contrast.

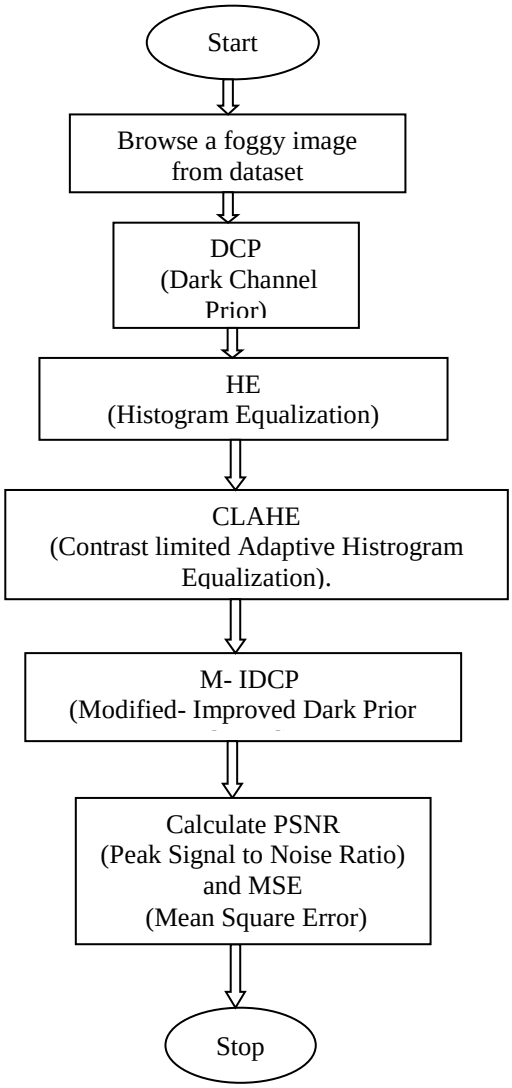

Fig: 2. *Flowchart of Proposed Algorithm*

RESULT SIMULATION

MENUBAR OF SIMULATED CODE OBTAINED BY MATLAB TOOLBOX SHOWN IN (FIG3)

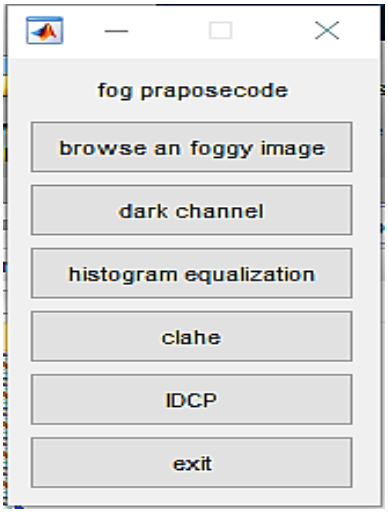

Fig: 3. *Menu bar of simulated code.*

In this menu bar of proposed code in fig (3), there are 5 steps:

a) Browse a foggy image and show foggy image in fig (4).
b) Apply on DCP model and show image of DCP in fig (5).
c) Apply on Histrogram equalization (HE) model and show image of HE output in fig (6).
d) Apply on CLAHE model and show output image of CLAHE in fig (7).
e) Apply modified new IDCP technique model and show output image of IDCP in fig (8). And exit code.

Foggy image output

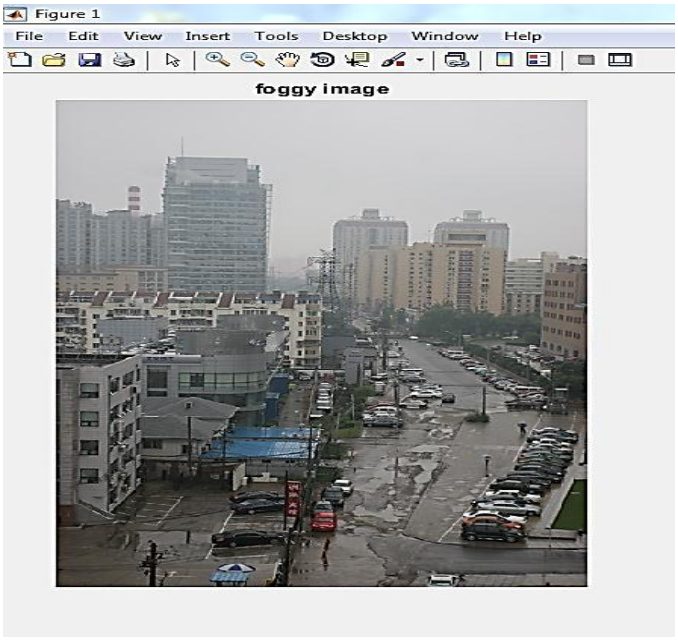

Fig: 4. *Browse a foggy image from dataset.*

DCP (Dark Channel Prior) image output

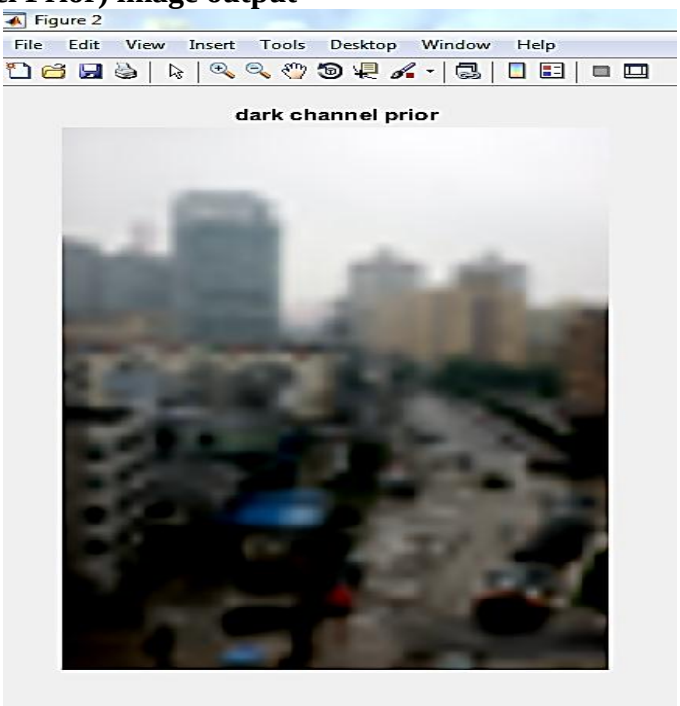

Fig: 5. *Apply DCP Technique on an original image to Eliminate fog from an image.*

HE (Histogram Equalization) image output

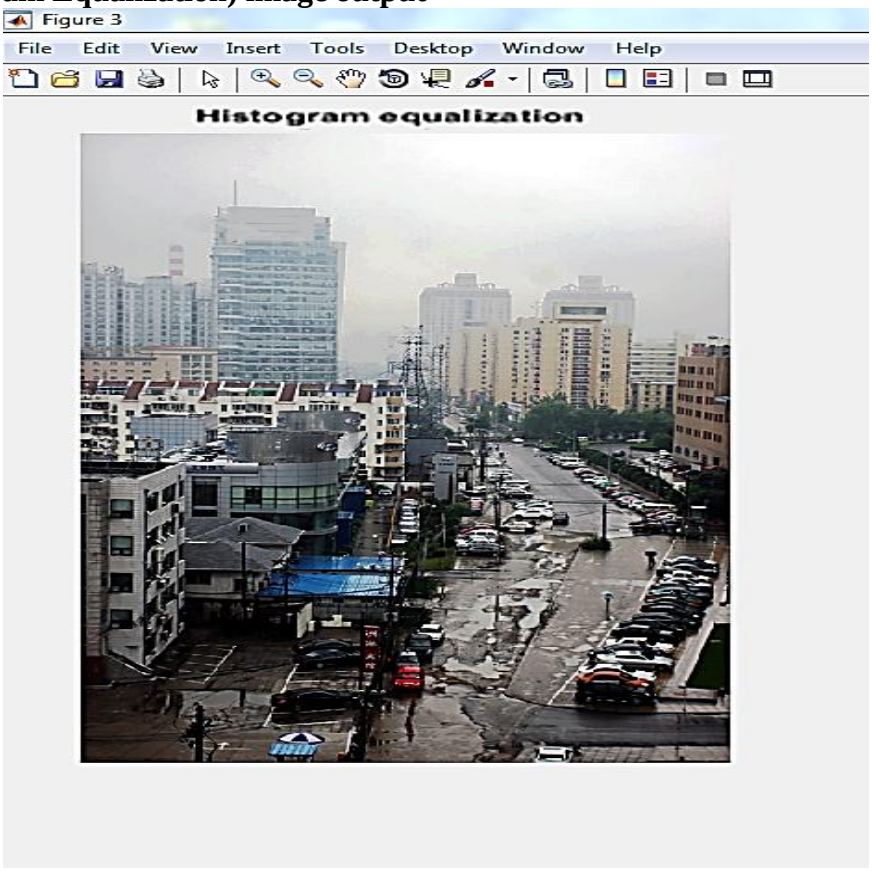

Fig: 6. *Apply Histogram Equalization Technique*

CLAHE image output

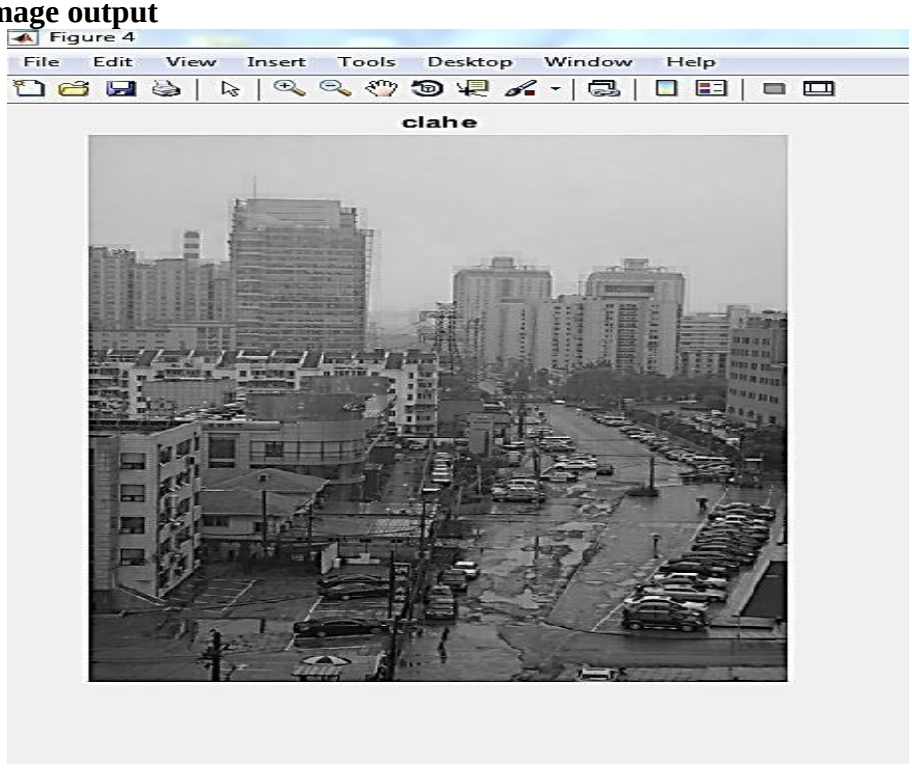

Fig: 7. *Apply CLAHE methods on an original image.*

M-IDCP (M-Improved Dark Channel Prior) image output

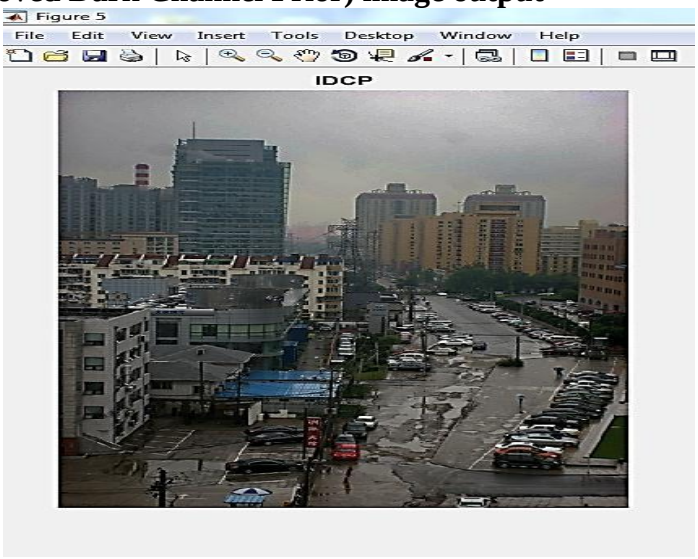

Fig: 8. *Select M- IDCP Technique for an original image.*

Higher the estimation of PSNR great is the outcome. From above table 1 and graph fig 9, it is clear that PSNR value increases on using new technique i.e. M- IDCP as compare with previous technique DCP, HE, CLAHE. Less value of MSE shows better result shown in table (1)and graph(fig:9) , it is clear that MSE value is decreasing on using M- IDCP shown in (fig.8) technique compare to other techniques.

Hence we get clearer image from foggy image on compare previous and new technique for PSNR and MSE for city-1 image. We get high quality image with clear visibility and vivid color on compare to base work.

Table: 1. *Comparisons previous techniques and New technique for PSNR and MSE for City-1 image*

Technique name	PSNR	MSE
DCP [6]	5.4818	1.4139
HE [6]	20.4811	1.3376
CLAHE [6]	28.9079	1
M-IDCP	37.6712	0.1352

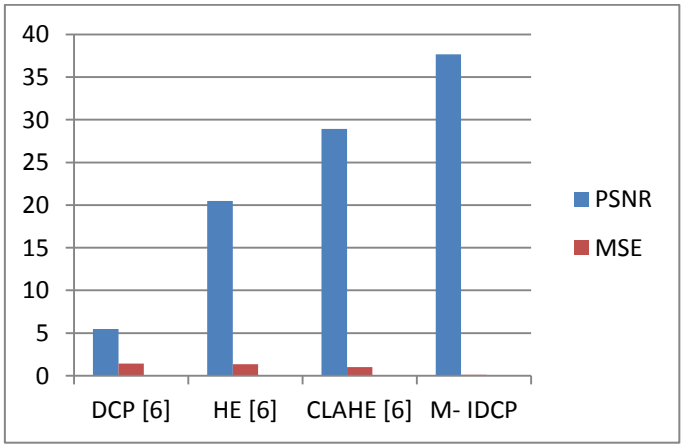

Fig: 9. *Graphics representation of Comparisons previous techniques and new technique for PSNR and MSE for City-1 image.*

Fig: 10. *Represent image result on apply of different technique at city-2*

Higher the value of PSNR good is the result. From above table 2 and graph (fig.10.a), it is clear that PSNR value increases on using new technique i.e. Improved IDCP as compare with previous technique DCP, HE, CLAHE shown in fig (10). Less estimation of MSE indicates better outcome appeared in table (2) and graph (fig.10.a), on utilizing M-IDCP appeared in fig (10) comparing on others. Hence we get clearer image from foggy image on compare previous and new technique for PSNR and MSE for city-2 image. We get high quality image with clear visibility and vivid color on compare to base work.

Table: 2. *Comparison previous techniques and New technique for PSNR and MSE for City-2 image.*

Technique name	**PSNR**	**MSE**
DCP [6]	6.3655	1.4139
HE [6]	19.4054	1.3143
CLAHE [6]	30.8371	1
M- IDCP	37.2197	0.1341

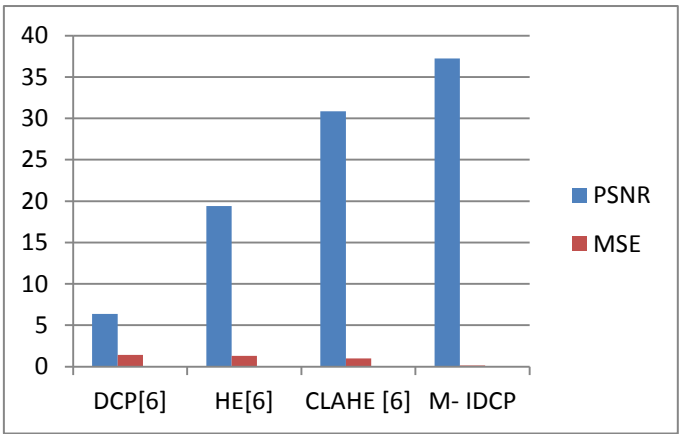

Fig: 10 (a). *Graphics representation Comparisons previous techniques and new technique for PSNR and MSE for City-2 image.*

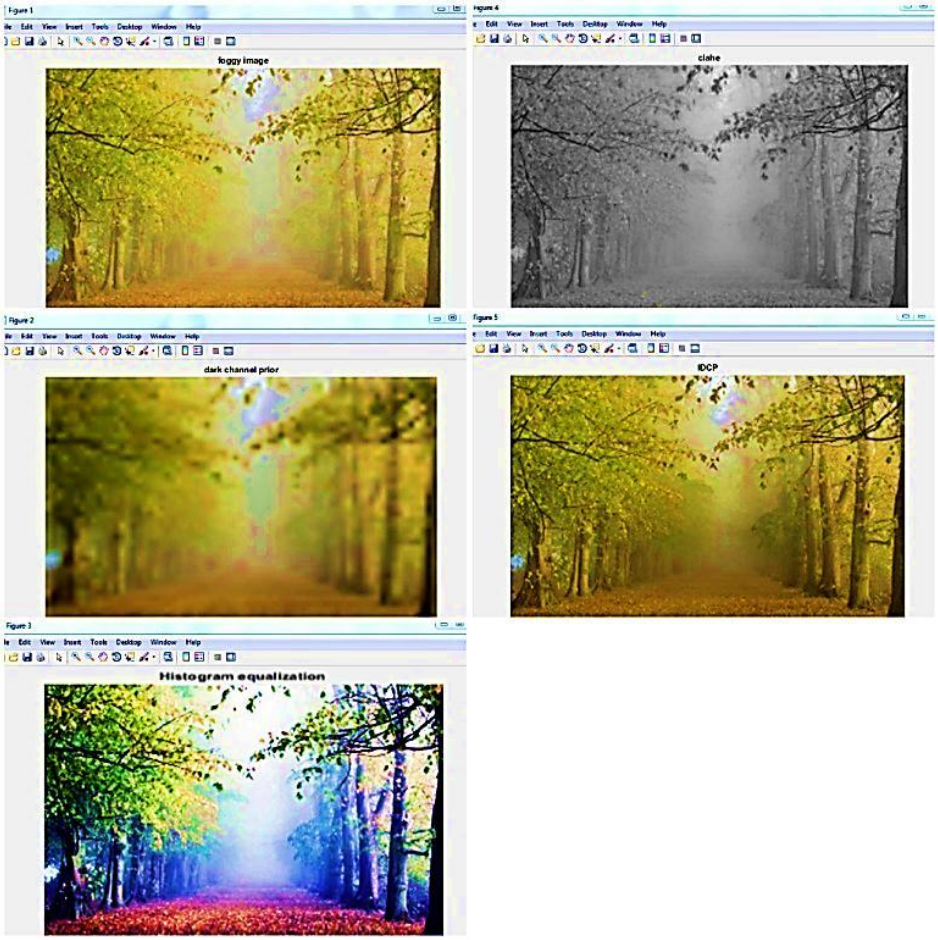

Fig: 11. *Represent image result on apply of different technique at tree image.*

Table: 3. *Comparisons previous techniques and New technique for PSNR and MSE for Tree image.*

Technique name	**PSNR**	**MSE**
DCP[6]	6.0997	1.4139
HE[6]	14.5676	1.3567
CLAHE[6]	25.2281	1
M-IDCP	39.1283	0.1354

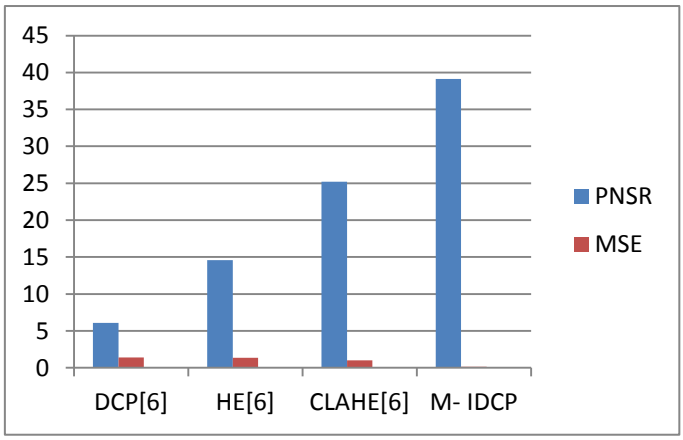

Fig: 11(a). *Graphics representation Comparisons previous techniques and new technique for PSNR and MSE for Tree image*

Higher the value of PSNR good is the result. From above table 3and graph (fig 11.a), it is clear that PSNR value increases on using new technique i.e. M-IDCP appeared in fig (11) on comparing past models, DCP, HE, CLAHE appeared in fig (11). Less estimation of MSE demonstrates better outcome appeared in table(3) and graph(fig.11.a), it is clear that MSE value is decreasing on using M-IDCP shown in fig(11) compare to other techniques

Hence we get clearer image from foggy image on compare previous and new technique for PSNR and MSE for Tree image. We get high quality image with clear visibility and vivid color on compare to base work.

CONCLUSION

From the above discussion and new results, it can be concluded that Modified-IDCP (M-IDCP) technique developed using the essential principles related to a problems domain. The Modified-IDCP (M-IDCP) technique proposed in this article produces better results as compare the best of a number of earlier techniques results implied for the solution of the problem. This proposed Defogging technique provides more actuate visibility of image for use in defogging application. With proposed work, The output picture is more clear than other picture and Halo effect is reduced on the basis of defogging parameters as PSNR and SNR are calculated for obtained output images. Higher value of PSNR parameters decides the better performance.

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