A NOVEL APPROACH FOR VIDEO DEHAZING USING GUIDED FILTER

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ABSTRACT In the present era,due to different weather conditions the images that are captured in these conditions gets degraded due to the presence of fog ,haze, rain and so on. Images of scenes captured in bad weather have poor contrasts and colors. This may cause difficulty in detecting the objects in the captured hazy images. Due to haze there is a trouble to many computer vision applications as it diminishes the visibility of the scene. Previously different techniques have been used to remove the fog and haze from the Images. But this method fails to detect the images with snowy ground. This paper presents the fog and haze removal method using guided filter. In this proposed method video is taken as input and processing can be done on that video. Atmospheric light and transmission map calculated finally using guided filter .the fog and haze removed from the video .Our method yields better performance than the other methods and provides accurate and valid results.

Keywords: **guided filter, video processing, Dehazing techniques, computer vision applications, color attenuation prior**

INTRODUCTION

A process of enhancing the visual quality of images due to no ideal image acquisition process (e.g., poor illumination, coarse quantization etc.)The principal objective of image enhancement is to process a given image so that the result is more suitable than the original image for a specific application. It attentuates or sharpens image features such as edges, boundaries, or contrast to make a graphic display more helpful for display and analysis. The enhancement doesn't increase the inherent information content of the data, but it increases the dynamic range of the chosen features so that they can be detected easily The greatest difficulty in image enhancement is quantifying the criterion for enhancement and, therefore, a large number of image enhancement techniques are empirical and require interactive procedures to obtain satisfactory results. Enhancement methods can be based on either spatial or frequency domain techniques.

Visibility improvement, contrast enhancement and features enhancement of images and videos captured in bad weather environment is very useful for many outdoor computer vision applications like video surveillance, object detection, object recognition, tracking, self navigating ground and air-based vision systems etc. Usually in bad weather environments like haze and fog the captured scenes suffer from poor visibility, contrast, brightness, luminance and distorted color. The conventional image and contrast enhancement techniques works well for some scenes but are not suitable for images with different depth regions because the haze and fog thickness depends on the depth of the scene. Images of outdoor scenes are usually degraded by the turbid medium in the atmosphere. Haze, fog and smoke are such phenomena due to atmospheric absorption and scattering. The irradiance is received by the camera from the scene point is attenuated along the line of sight. Furthermore, the incoming light is blended with the air-light reflected into the line of sight by atmospheric particles. The degraded images loses contrast and color fidelity. Since the amount of scattering depends on the distance of the scene points from the camera.

Poor visibility degrades image quality as well as the performance of the computer vision algorithms such as surveillance system, object detection, tracking and segmentation. Poor visibility is due to occurrence of atmospheric substances which absorbed light in between the object and camera. They can be the water droplets that are there in the air. These droplets are very small in size and they continuously float in the air and leads to the filths of the image when clicked in the bad weather conditions such as fog, haze and smog etc. Fog is a group of liquid water droplets or ice crystals hanging in the air at or near the Earth's surface. The term "fog" is typically distinguished from the more generic term "cloud" in that fog is low-lying . In order to overcome the degradation in the image, visibility restoration methods are applied to the image so as to obtain a better quality of image. Visibility restoration can be considered as the different methods that aim to decrease or eradicate the degradation that have occurred while the digital image was being captured. The degradation may be due to various factors like relative camera object motion, blur due to miss focus of camera, relative atmospheric turbulence and others. In this we will discuss about the degradations due to bad weather such as fog, haze, rain, snow and dust in an image . Light gets scattered in the atmosphere before it reaches the camera due to the presence of haze. The image quality of outdoor scenes in the fog and haze weather condition is usually degraded by the scattering of a light before reaching the camera due to these large quantities of suspended particles (e.g. fog, haze, smoke, impurities) in the atmosphere. This scattering of light is caused due to the attenuation and airlight. The light coming from the object to be clicked gets scattered due to the presence of fog and some part of it also travels to the camera and causes shift of the image being clicked. So in order to remove this color shift in the image various haze removal methods are used in order to improve the quality of the image . Haze removal is a tough task because fog depends on the unknown scene depth information. Hence removal of fog requires the estimation of airlight map or depth map. Fog effect is the function of distance between camera and object .

In foggy weather degradation, invisibility is caused by attenuation and airlight. A light beam travels from a scene point through the atmosphere, the light intensity gets attenuated due to the atmospheric particles, and this phenomenon is called attenuation which decreases the contrast in the scene as well as variation of scene color, which finally leads to a poor visual perception of the image. Light coming from the source is scattered by fog and part of it travels towards the camera and the remaining part is scattered in different directions. This phenomenon is called airlight. Airlight adds whiteness into the scene.

I. EXISTING METHOD

Color Attenuation Prior to detect or remove the haze from a single image is a challenging task in computer vision, because little information about the scene structure is available. In spite of this, the human brain can quickly identify the hazy area from the natural scenery without any additional information. This inspired us to conduct a large number of experiments on various hazy images to find the statistics and seek a new prior for single image dehazing. Interestingly, we find that the brightness and the saturation of pixels in a hazy image vary sharply along with the change of the haze concentration.

In the haze-free condition, the scene element reflects the energy that is from the illumination source (e.g., direct sunlight, diffuse skylight and light reflected by the ground), and little energy is lost when it reaches the imaging system. The imaging system collects the incoming energy reflected from the scene element and focuses it onto the image plane. Without the influence of the haze, outdoor images are usually with vivid color. In hazy weather, in contrast, the situation becomes more complex. There are two mechanisms (the direct attenuation and the airlight) in imaging under hazy weather. On one hand, the direct attenuation caused by the reduction in reflected energy leads to low intensity of the brightness. To understand this, we review the atmospheric scattering model. The term $J(x)t(x)$ is used for describing the direct attenuation. It reveals the fact that the intensity of the pixels within the image will decrease in a multiplicative manner. So it turns out that the brightness tends to decrease under the influence of the direct attenuation. On the other hand, the white or gray air light, which is formed by the scattering of the environmental illumination, enhances the brightness and reduces the saturation. We can also explain this by the atmospheric scattering model.

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

The rightmost term $A(1 - t(x))$ represents the effect of the airlight. It can be deduced from this term that the effect of the white or gray airlight on the observed values is additive. Thus, caused by the airlight, the brightness is increased while the saturation is decreased. Since the airlight plays a more important role in most cases, hazy regions in the image are characterized by high brightness and low saturation. What’s more, the denser the haze is, the stronger the influence of the airlight would be. This allows us to utilize the difference between the brightness and the saturation to estimate the concentration of the haze. Since the concentration of the haze increases along with the change of the scene depth in general, we can make an assumption that the depth of the scene is positively correlated with the concentration of the haze and we have:

$$s(x) - v(x) = c(x) \; \alpha d(x) \quad - (2)$$

Where d is the scene depth, c is the concentration of the haze, v is the brightness of the scene and s is the saturation. We regard this statistics as color attenuation prior.

To detect or remove the haze from a single image is a challenging task in computer vision, because little information about the scene structure is available. In spite of this, the human brain can quickly identify the hazy area from the natural scenery without any additional information. This inspired us to conduct a large number of experiments on various hazy images to find the statistics and seek a new prior for single image dehazing. Interestingly, we find that the brightness and the saturation of pixels in a hazy image vary sharply along with the change of the haze concentration. A natural scene to show how the brightness and the saturation of pixels vary within a hazy image. In a haze-free region, the saturation of the scene is pretty high, the brightness is moderate and the difference between the brightness and the saturation is close to zero. But it is observed the saturation of the patch decreases sharply while the color of the scene fades under the influence of the haze, and the brightness increases at the same time producing the high value of the difference in a dense-haze region, it is more difficult for us to recognize the inherent color of the scene, and the difference is even higher. It seems that the three properties (the brightness, the saturation and the difference) are prone to vary regularly in a single hazy image.

FAST FOURIER TRANSFORM

Snappy Fourier Transform (FFT) is the snappier and capable procedure for Discrete Fourier Transform (DFT). Discrete Fourier Transform is the change which takes the discrete banner in time territory and changes that banner in its discrete repeat space depiction. This property of DFT means the centrality of DFT in the area of range examination. FFT being the quick and discrete nature similarity DFT is suitable for the banner's range examination in MATLAB dynamically. Discrete Fourier Transform empowers us to figure an estimation of the Fourier Transform on a discrete course of action of frequencies from a discrete game plan of time tests. A snappy Fourier change (FFT) computation figures the discrete Fourier change (DFT) of a gathering, or its retrogressive. Fourier examination changes over a banner from its special region (consistently time or space) to a depiction in the repeat space and the a different way. A FFT rapidly procedures such changes by factorizing the DFT grid into a consequence of pitiful (generally zero) factors.[1] as needs be, it makes sense of how to reduce the multifaceted way of enrolling the DFT from,

$$\mathrm{F(x,y)} = \sum_{m=0}^{M-1}\sum_{\mathrm{n=0}}^{\mathrm{N-1}} f\ (m,n)e^{-j2\Pi(x\frac{m}{M}+y\frac{n}{N})} \quad -(3)$$

which rises in case one basically applies the importance of DFT, to, where is the data assess. Fast Fourier changes are extensively used for a few applications in outlining, science, and number juggling. The fundamental considerations were progressed in 1965, however a couple of figurings had been settled as perfect on time as 1805.In 1994, Gilbert Strang delineated the FFT as "the most essential numerical calculation of our lifetime"and it was joined into Top 10 Algorithms of twentieth Century by the IEEE diary Computing in Science and Engineering. There are a wide grouping of FFT computations including a wide gathering of science, from clear complex-number math to gathering hypothesis also, number theory; this article gives a plan of the open techniques and some of their general properties, while the specific incorporate are depicted accomplice articles related underneath. The DFT is secured by deteriorating a procedure of traits into parts of different frequencies. This operation is significant in many fields (see discrete Fourier change for properties and usages of the change) yet figuring it particularly from the definition is frequently too move to perhaps be valuable. A FFT is a way to deal with oversee figure a close result more quickly: enrolling the DFT of N centers in the unadulterated way, using the definition, takes O(N2) arithmetical operations, while a FFT can manage the same DFT in just $O(N \log N)$ operations. The refinement in speed can be gigantic, especially for long educational archives where N may be in the thousands or millions. All around that truly matters, the estimation time can be reduced by a few offers of size in such cases, and the change is by and large diverging from N log N. This epic change made the figuring of the DFT sensible; FFTs are of heavily criticalness to a wide gathering of uses, from bleeding edge hail prepare and unraveling for the most part differential conditions to calculations for lively development of huge numbers. The best-known FFT calculations rely on upon the factorization of N, however there are FFTs with O (N log N) strangeness for all N, regardless of for prime N. Different FFT figuring's essentially rely on upon the way that is a N-th primitive base of solidarity, and along these lines can be related with undifferentiated from changes over any limited field, for example, number-theoretic changes. Since the inverse DFT is the same as the DFT, yet with the switch sign in the sort and a 1/N consider, any FFT estimation can without a ton of a develop be adjusted for it.

$$F(m,n) = \frac{1}{MN}\sum_{m=0}^{M-1}\sum_{n=0}^{N-1} f(x,y)e^{-j2\Pi(x\frac{m}{M}+y\frac{n}{N})} \quad -(4)$$

$$F(m,n) = \sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)e^{-j2\Pi x\frac{m}{M}}\, e^{-j2\Pi y\frac{n}{N}} \quad -(5)$$

II. PROPOSED METHOD

GUIDED FILTER

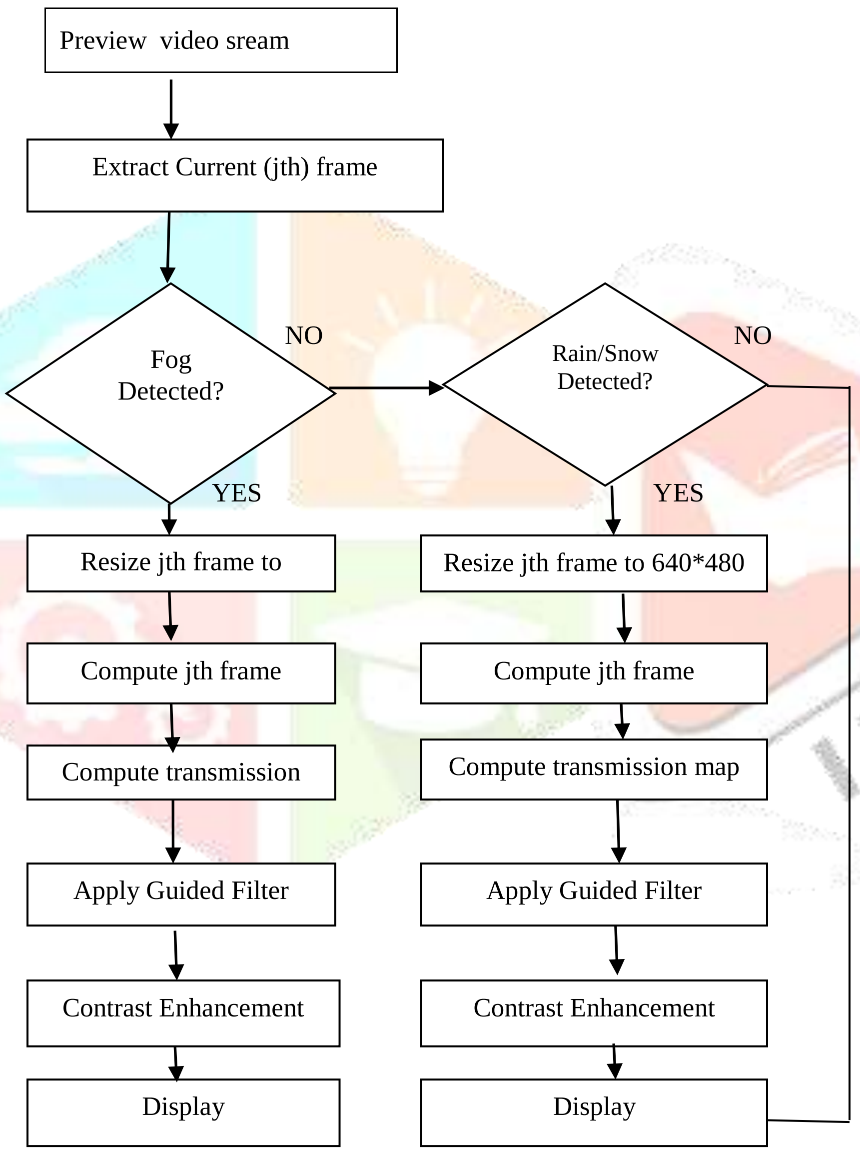

Figure1: Proposed Method for Fog removal in video

Input video:

In this work we initially expel dimness from picture, and after that enhance the nature of picture and reestablished the deceivability of unique picture and hence get a great cloudiness free picture utilizing Image preparing approach. The trial comes about exhibit that the proposed method delivers a palatable reestablished picture. By utilizing dimness evacuation calculations, we can improve the security and strength of the visual framework. The fog expulsion systems can be ordered into two classifications: video upgrade and picture rebuilding. Picture improvement does exclude the motivation behind why mist corrupts picture quality. This system improves the complexity of fog video however it prompts loss of data in picture. In this work, we present an enhanced single video de right of passage calculation, which is construct Dark divert earlier Estimation in light of chose district to evaluate the barometrical light, and get more precise outcome. Here, It portrays the arrangement of a fog video as takes after:

$$I(x)=j(x)t(x)+A(1-t(x)) \quad -(6)$$

Where I is the watched fog video, J is the scene brilliance, An is the worldwide climatic light, and t is the medium transmission. It depicts the bit of the light that is not scattered and achieves the camera. The objective of dimness evacuation is to recoup J, An, and t from I.

Pre-Processing:

In our plan, we initially transfer cloudy picture then goes towards the further preparing. As a pre-handling step is particularly advantageous considering that it is as of now important for assessing the environmental light and transmission delineate.

Dark Channel Prior Estimation:

we have a Dark Channel Prior, for single video fog evaluation. Dark channel earlier strategy can create a characteristic fog free video. Be that as it may, in light of the fact that this approach depends on actually free supposition in a neighborhood fix, it requires the autonomous segments shifting essentially. The dim channel earlier depends on the accompanying perception on dimness free outside pictures: in the vast majority of the non-sky patches, no less than one shading channel has low power at a few pixels. At the end of the day, the base force in such a fix ought to have a low esteem. Formally, for a video J, we characterize:

$$J^{dark}(x) = \min_{c\epsilon\{r,g,b\}}(\min_{y\epsilon\Omega(x)} (J^c(y))) \quad -(7)$$

Where J' is a shading channel of J and Q(x) is a neighborhood fix focused at x. Our perception says that with the exception of the sky area, the power of Jdark is low and has a tendency to be zero, if J is a dimness free open air video. We call Jdmk the dull channel of J, and we call the above measurable perception or information the dim channel earlier. The low forces oblivious channel are for the most part because of three variables: a) Shadows. e.g., the shadows of autos, the shadows of leaves, b) Colorful questions or surfaces. e.g., any protest (for instance, green grass/tree/plant, blue water surface; b); c) Dark questions or surfaces. e.g., dull tree trunk and stone.

Estimating the Atmospheric Light:

The air light was assessed from fog picture by utilizing dim channel earlier with a settled fix measure. This technique is productive in an assortment of video. In any case, in some exceptional pictures, for instance videos with numerous light sources, the estimation will be invalid. In the event that the min separating is finished with a too little window, then it might get light sources in the video, which can degenerate the estimation The red pixels demonstrate the gathering of pixels the calculation finds the maximum R, G, and B values among to collect the environmental light gauge.

Remembering the true objective to overcome the artifacts introduced by individual channel, another edge sparing execution known as Guided picture channel is suggested that will channel the yield dependent upon the information of the course picture. Guided video filtering is one of the spatial space change strategy in which the isolating yield is locally an immediate alter of the course video. Guided channel has incredible edge-defending smoothening properties and does not encounter the evil impacts of the incline reversal old rarities that are seen while using equal channel. It can perform better at the pixels near the edge when appeared differently in relation to separate channel. The guided channel is furthermore a more non particular thought past smoothing. By using the heading video, it makes the isolating yield more composed and less smoothed than the data. It can trade the structures of the bearing.

picture to the filtering yield, enabling new isolating applications, for instance, dehazing and guided feathering. Also, guided channel gets the snappy and non-figure characteristics of straight time count and gives an immaculate decision to continuous applications in case of HD filtering. From this time forward, it is thought to be one of the speediest edge ensuring channels. Guided channel all things considered has an O(N) time (in the amount of pixels N) rectify estimation for both diminish scale and shading pictures, paying little personality to the bit measure and the extent of constrain. O (N) time addresses that the time multifaceted nature is self-sufficient of the window radius(r) and consequently subjective piece sizes can be used as a piece of the applications.

MSE (Mean Square Error):

In statistics, the mean squared error (MSE) or mean squared deviation (MSD) of an estimator (of a procedure for estimating an unobserved quantity) measures the average of the squares of the errors or deviations—that is, the difference between the estimator and what is estimated.

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

Psnr (Peak Signal To Noise Ratio):

Peak signal-to-noise ratio, often abbreviated **PSNR**, 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. Because many signals have a very wide dynamic range, PSNR is usually expressed in terms of the logarithmic decibel scale.

PSNR is most commonly used to measure the quality of reconstruction of lossy compression codecs (e.g., for image compression). The signal in this case is the original data, and the noise is the error introduced by compression. When comparing compression codecs, PSNR is an approximation to human perception of reconstruction quality. Although a higher PSNR generally indicates that the reconstruction is of higher quality.

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$

Video quality Measurement:

It is a characteristic of a video passed through a video transmission/processing system, a formal or informal measure of perceived video degradation (typically, compared to the original video). Video processing systems may introduce some amount of distortion or artifacts in the video signal, which negatively impacts the user's perception of a system. For many stakeholders such as content providers, service providers, and network operators, the assurance of video quality is an important task.

Video quality evaluation is performed to describe the quality of a set of video sequences under study.Video quality can be evaluated objectively (by mathematical models) or subjectively (by asking users for their rating). Also, the quality of a system can be determined offline (i.e., in a laboratory setting for developing new codecs or services), or in-service (to monitor and ensure a certain level of quality).

Guided Filter:

The imguided filter function performs edge-preserving smoothing on an image, using the content of a second image, called a *guidance image*, to influence the filtering. The guidance image can be the image itself, a different version of the image, or a completely different image. Guided image filtering is a neighborhood operation, like other filtering operations, but takes into account the statistics of a region in the corresponding spatial neighborhood guidance image when calculating the value of the output pixel. If the guidance is the same as the image to be filtered, the structures are the same—an edge in original image is the same in the guidance image. If the guidance image is different, structures in the guidance image will impact the filtered image, in effect, imprinting these structures on the original image. This effect is called *structure transference*

Edge-preserving smoothing is an image processing technique that smooths away textures whilst retaining sharp edges. They are the median filter,

the bilateral filter, the guided filter and anisotropic diffusion. Given the definition of the guided filter, we first study the edge-preserving filtering property. The guided filter with various sets of parameters. Here we investigate the special case. We can see that the guided filter behaves as an edge-preserving smoothing operator. The edge-preserving filtering property of the guided filter can be explained intuitively.

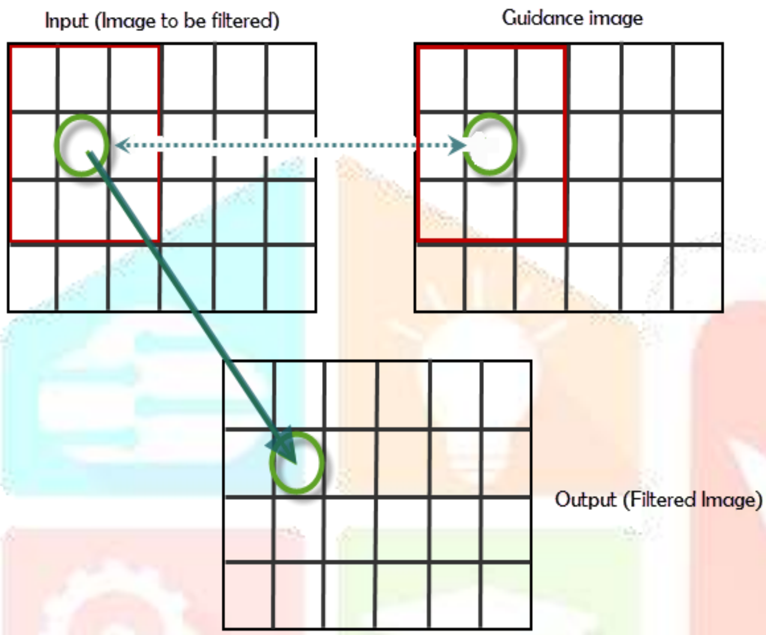

Figure2:explanation of guided image filtering

IV .RESULTS

Table analysis:

S.NO	parameters	Existing method	Proposed method
1	PSNR	67.9435	69.3837
2	MSE	0.0104	0.0075

In order to evaluate the performance of the proposed method, we implemented the proposed method and FFT by using MATLAB software. Five common used test videos were used in our simulation which is shown below.

Figure 2: Fog removal from video (a), (b) & (c) input videos and (d) is output video

Figure 3: Fog removal from video (a), (b) & (c) input videos and (d) is output video

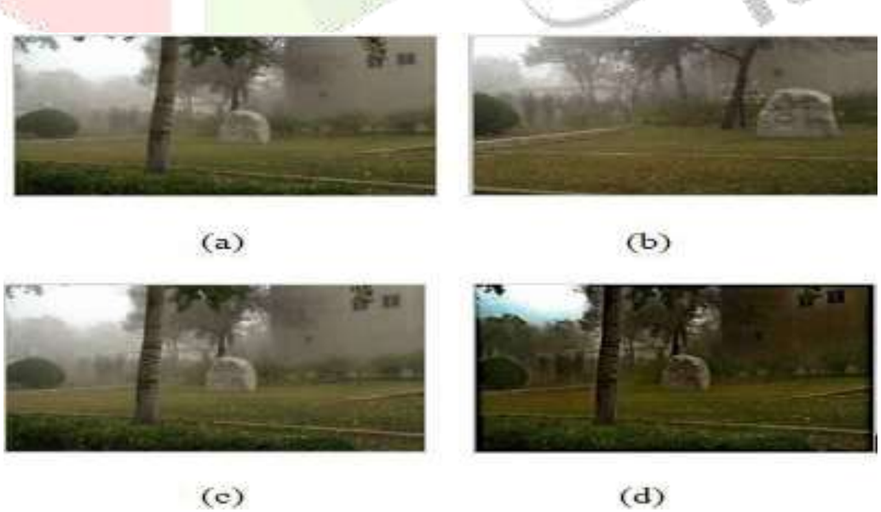

Figure 4: Fog removal from video (a), (b) & (c) input videos and (d) is output video

Figure 5: Fog removal from video (a), (b) & (c) input videos and (d) is output video

COMPARISIONS:

PSNR		MSE		VQM	
Proposed method	**Existing method**	**Proposed method**	**Existing method**	**Proposed method**	**Existing method**
69.48	67.94	0.05	0.07	0.99	0.90
62.38	60.94	0.18	0.22	0.98	0.89
63.10	61.88	0.17	0.19	0.97	0.76
65.13	64.11	0.11	0.11	0.96	0.67

Table:for comparisions of proposed method and existing method for calculating bargraphs

In this paper, we adopted peak-signal-to-noise-ratio (PSNR), MSE and VQM to measure the visual quality of a video. For the above five foggy videos the metrics are calculated and specified below

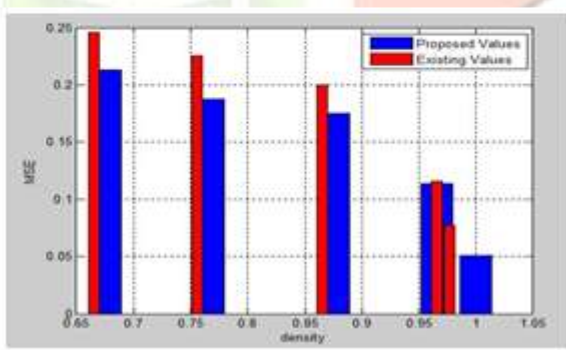

Figure4:Bar graph for existing and proposed value of MSE and density

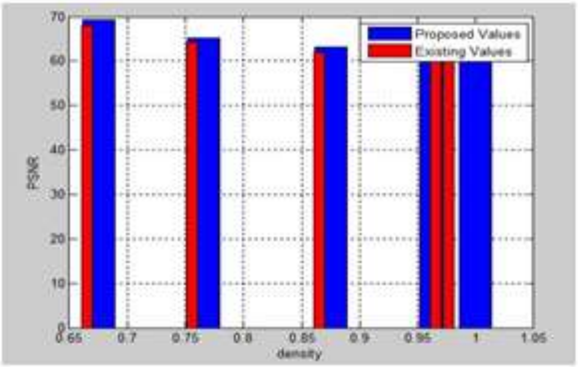

Figure5:Bar graph for existing and proposed value of PSNR and density

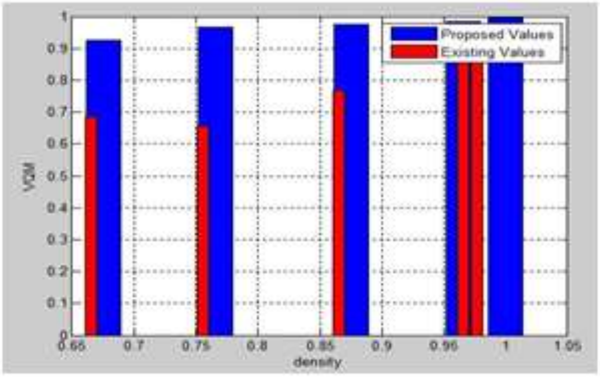

Figure6:Bar graph for existing and proposed value of VQM and density

V .CONCLUSION

This paper presents a Guided filter method for effective suppression of halo effects in the unrefined transmission map. Through the use of the proposed Guided filter with dark channel prior, both excellent dehazing effect and high processing speed can be achieved as demonstrated by our experimental results. Additionally, annoying halo effects along depth edges have been significantly suppressed in restored images. The experimental results show that the dark channel prior combined with the proposed Guided filter exhibits superior haze removal effects and much faster refinement speed than can the modern filter.

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