Image Reconstruction and Improve Image Visibility using Super-Resolution Technique

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Abstract— **In current time the importance of an image is incredible as its use was not limited as it was in the old days. It is now used in much higher levels like describing an environmental weather, traffic analysis etc. But as all know that, capturing an image very much weather dependent. Its clarity depends completely upon the external environment. Hence it is affected due to the bed whether or atmosphere. So our purpose in the paper is to focus on the various ways to convert those blurred, foggy and noisy low-resolution image into a high-resolution image. We focus to achieve this by using Super-Resolution technique.**

Keywords—Image processing, Foggy Images, Fog removal method, Super-resolution techniques, Quality enhancement.

I. Introduction

An image is affected by various things like rain, fog, mist, haze, and smoke as it's clarity of an image is directly dependent on external atmosphere. Even in coastal regions we get some worst conditions sea spray where light are usually composed of water droplets. The visibility distance is measured as the difference between fog, mist, and haze. A mere deflect and scatter in the light molecules and gases can affect the picture quality in the environment. Visibility is mostly disturbed by spreading particles between image capturing device and object. Particles scatter light coming from the sun and reflected by an object to capture device lens, and the rest of the sky during the line of sight of the spectator, therefore contrast between the object and the background [5] is reduced.

Fig.1. Effect of fog during bad weather condition on road traffic

The picture quality of images completely depends on the condition of weather .So when the weather is good, the image will be ok, but when weather is bad the image will be disturbed. As foggy is one of the worse weather condition, the contrast and clarity of an image captured in foggy weather is lower, and some color information is lost, which affects the following analysis and recognition. Most image recognition systems are made for normal weather, it is more valuable to restore the foggy degradation image and improve the image quality [6]. As image quality is weather dependent so it is very obvious that, if the weather is bad then image quality decrease and objects are not identified. One most Universal weather environment is fog that having blurred or dim effect on the landscape, the atmospheric visibility and darkness that Causes to the refuse of image contrast, quality and vagueness to the image is generated.

There are reduced visibility and clarity records in awful weather condition due to the extensive occurrence of atmospheric particles having large volume, darkness and Distribution in the contributing medium. atmospheric Light reflected by any particles or object is absorbed and scattered by particles presents in Atmosphere environment, degradation is caused in the clarity and visibility of the scene. With the fast development of digital image processing technology, video surveillance system is used widely. The quality of videos and images is caused by the condition of weather, it will be better when weather is good, while it will be worse when weather is bad. Foggy is the main bad atmosphere or weather, the image obtained in foggy weather has low resolution, contrast and clarity, and information is also lost behind that image, which affects the following analysis and recognition [1]. In our country, foggy is dreadful and worse with the economic development. Most image regenerating systems are made for normal weather, so the restoration of foggy degradation image to improve the image quality has high application value.

Because of the difficulties in dealing with awful conditions when capturing images many types of techniques are applied on the low filters to remove the effects of noise, but found inappropriate for the foggy images. Foggy images has plenty of vaporizer atoms in the environment present in a foggy weather break the path of light, also influence the distribution of the light spread. Hence it affects the feature of the image and the contrast of the image fall according to raise the distance from camera to object. So the focus point for many

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researchers till now is on foggy removal image enhancement and many methods are proposed for foggy degrading images.

II. RELETED WORK

An improved idea first came from Tsai and Huang. A frequency domain approach was introduced for demonstration and analyzing the ability to reconstruct a single improved resolution image from several or different down-sampled, noise-free versions of it [1]. Kim, Bose and Valenzuela proposed a weighted recursive least squares algorithm based on sequential or linear estimation theory for filtering and interpolating in the Fourier transform or wave number domain [2].For reconstruction of a high-resolution image from a registered sequence of frames related to noisy, foggy and blurred frames, main purpose is rescaling and displaced horizontally and vertically from each other.

To remove weather effect using histogram equalization [3, 4], two main methodologies are applied; first one is global histogram equalization and last is local histogram equalization. The first is very smooth and fast, but the only demerit is that the resultant image is poor. And the other method needs high calculation costs. Hence many researchers have come with several better algorithms which are extended version of histogram equalization, the method in paper [5, 6], is using an area segmentation method. The intension is to remove a flat area from the image ,the local histogram equalization method can be used in the non-flat area of the image. Because background motion is different from moving objects, carrying objects can be extracted from the motion flow vectors. So real-time implementation is difficult or expensive because the computational complexity of optical flow is high.

Another rigid model was introduced by Irani and Pelegin on image registration process and then applied the iterative back projection technique from computer-aided tomography. Mann and Picard proposed the projective model in image recognition as well as registration because their images were acquired and assimilated with a video camera[9]. Lertrattanapanichand used a projective model for video mosaicing and high-resolution image reconstruction.

According to the foggy image model and the prior knowledge the depth information of the foggy image is extracted. Then we have to estimate and adjust the transmission ratio of the atmosphere light is calculated and adjusted, and the atmosphere light A is also estimated. Finally gamma is adjusted to get the final enhancement image [5]. The speed is faster than the one in reference. Seen from the experimental results the method seen in the paper is suitable for the application need fast computation. The anti-blur effect of the algorithm stated in this paper is better than the one obtained from retinex method.

Table I describes all other techniques comparison with respect to frequency filtering or frequency domain for image enhancement.

TABLE I. FREQUENCY TECHNIQUES FOR IMAGE ENHANCEMENT

Year	Author	Techniques used	Application
2014	Ashish Saxena	FFT	Fog removal and Quality enhancement
2012	Ali, M.A	Discrete Cosine transform (DCT)	Image/video Compressing
2012	Iwanami,T.	Dynamic Histogram Equalization technique	Medical Image, Low quality video
2011	Naidu V.P.S.	Multiresolution image analysis	well suited for real time applications
2010	Xuan Dong	Inverting the input low lighting video; dehaze algorithm	Traffic monitoring; Medical Imaging
2010	Shan Du	Adaptive Region based Method	Face Recognition
2010	Sara Hashem	Genetic algorithms	Compute high dynamic range image processing
2009	Tzimiro poulos, G.	FFT-based correlation	Images from popular database
2009	Viet Anhngu yen	Video reconstructed from multiple compressed copies of video content	Compression Video
2008	R.C. Gonzale	Global Histogram Equalization	Image/ Video Security Surveillance

III. PROPOSED SYSTEM

Our proposed work to analyze and compute image quality enhancement in two phases. The blurred is extracted, fog from an image. Second step enhance quality of image for improved visibility and claritywith the use of Super-Resolution technique.

A. Computational model of foggy image

In first phase, collecting the depth information of the foggy image and it extracted according to the foggy image model and the transmission ratio of the atmosphere light is estimated

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

In which $I(x)$ is the foggy image, $J(x)$ the image without fog, A the atmosphere light, $t(x)$ the ratio of transmission. The object of remove fog is to recover $J(x)$, A and $t(x)$. The first item in the right hand side of equation (1) $J(x)\, t(x)$ is called direct attenuation, and the second item A (l-t(x)) is called air light component.

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The transmission ratio of the atmosphere light is expressed as,

$$t(x) = e^{-\beta d(x)} \qquad (2)$$

Accordingly, it obtained

$$t(x) = \frac{||A - I(x)||}{||A - J(x)||} = \frac{A^c - I^c(x)}{A^c - J^c(x)} \qquad (3)$$

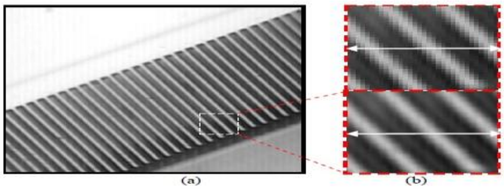

Fig. 2. Estimation of transmission Ratio.

The scheme of fog removal based on prior knowledge

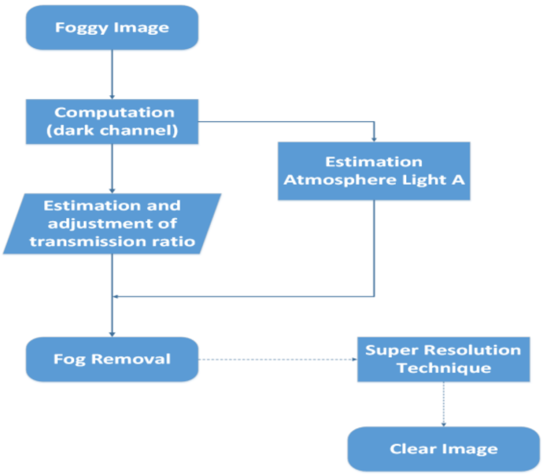

Figure 3. The scheme of fog removal

1. Estimation of transmission Ratio.
2. Adjustment of transmission Ratio.
3. Recovering source image.
4. Estimation atmosphere light and fog.
5. Apply Super resolution technique Fogremoved image.

B. Fog removal on the basis of pre- knowledge and Quality enhancement

The Super-Resolution is an efficient implementation of DFT and is used in Image processing. It is used to convert any picture from its spatial domain to its frequency. It is faster to perform any computation or to apply any filter in frequency domain rather than spatial domain[13].

Because the calculation of the DFT is reallycostly the Super-Resolution came into existence and hence it is used to minimize the cost. With the use of Super-Resolution the computational difficulties are decreased from N_2 to $\log_2 N$. For example, for a picture of size 300×300 pixels the processing time needed is approximately two minutes on a general purpose computer. The same computer would take 30 times longer (60 minutes) to calculate the DFT of the same image of size 300×300.

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To convert an image into its actual components and imaginary components, Super-Resolution is used which is a depiction of the image in the frequency. If an image is in the form of input, then by using pixel spread function number of frequencies is same as the number of pixels in the image.

Super-Resolution generates results as complex number and this numbers have greater range than spatial domain. Hence accuracy represent these values are stored. Because the range of coefficient generated is very large to be displayed on the screen so these values are converted to another formatted as dimension values height*width to decrease the range and make able to displayed on screen. The results obtained from Super-Resolution are though have more clarity along with that some more parameter for image.

IV. SIMULATION AND RESULT

Proposed work has been deployed in ASP.NET version 2010 on hardware platform of Pentium(R) Dual-core @3.20 GHz, 1-GB cache with windows 7 operating system. This work is applied on 300 × 300 resolution test images and compared with exiting methods for different outdoor environments.

TABLE. II. COMPARE RESULT WITH DIFFERENT EXISTING SYSTEM

Output image	**(a)**	**(b) [5]**	**(c) [12]**	**(d)**
Parameter	Input foggy image	Existing system output	Existing system output	Proposed system
Fog content	High	Medium	Low	Low
Brightness	Poor	Poor	Poor	Good
Contrast	Poor	Poor	Average	Good
sharpness	Poor	Poor	Average	Good
Total visibility	Very poor	Poor	Good	Good

Table II gives detailed comparison of proposed work with existing [5], [12] with respect to various parameters like fog content in image. Parameters on which comparison is done are fog content in image, brightness of image, and contrast of image, sharpness and overall visibility of object in picture. We

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have found that image given as input has high fog content therefore visibility of object in image was very poor. When method [5] is applied on input image the output obtained is a bit clear image with poor brightness, low contrast and poor sharpness hence total visibility was found not very clear. Same input image was processed with [12] result found pretty well on the parameter of contrast, sharpness hence total visibility. Proposed method show good results on above parameters in various outdoor environments such as road, garden and heavy fog.

Figure 4. Visual comparison of the dehazing results of these methods.

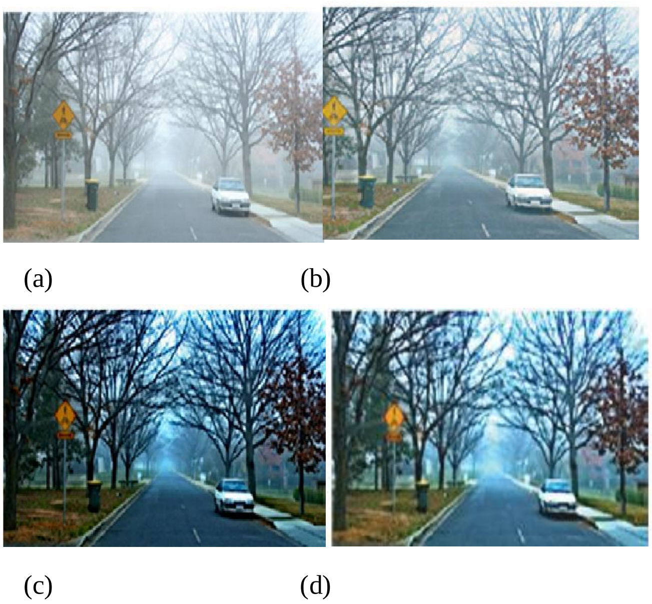

Figure 5. Visual comparison of the dehazing results of these methods.

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