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Review Paper on Image Dehazing Techniques

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***Abstract*— Image dehazing is the process of visually improving the degraded visibility caused by atmospheric conditions. The main objective of single image dehazing is to remove the haze or fog in the image completely without degradation. Some common applications of this technique include video surveillance, underwater imaging, image composting, image editing, interactive photomontage etc. In nowadays deep learning methods have progressed in the field of image dehazing. This paper gives a brief review of the existing image dehazing approaches. This paper presents a brief survey of different image dehazing techniques and provides a relative comparison between these techniques for dehazing.**

Keywords—Image Dehazing; Image Enhancement; Image Restoration.

I. INTRODUCTION

Image dehazing has been an active area of research for more than a decade. Generally, the problem of haze or fog is caused by bad weather condition and it depends on the particle type, size and concentration. Bad weather condition is responsible for shift in color and reduce the contrast of an image or video. Changes in the color or contrast greatly impact on the object or the surveillance system. Image dehazing is the process of scenically improving the degraded visibility caused by atmospheric conditions. Main aim is to restore the scene radiance from the hazy image. Fog or Haze decreases the clarity of underwater images and satellite images. Most automatic systems are firmly depending on definition of input images, break to work normally caused by degraded images.

There are mainly two different types of dehazing: Daytime and nighttime dehazing. There are various dehazed methods for daytime dehazing. Day time haze model is a linear equation consist of transmission map and the airlight. To produce a stately daytime dehazing image, it has proved to estimate its corresponding transmission map and airlight. Aside from daytime dehazing, night dehazing is also a significant topic.

In nighttime condition, the dehazing is a challenging task and the atmospheric light is not constant in the entire image. Aside from daytime dehazing, its mainly due to the illumination from different sources like street lights, vehicle lights etc. Then the condition of block effect is induced on the image.

The entire paper is organized as follows: Section I gives brief introduction, Section II gives survey of different methods of dehazing and Section III conclusion followed by references.

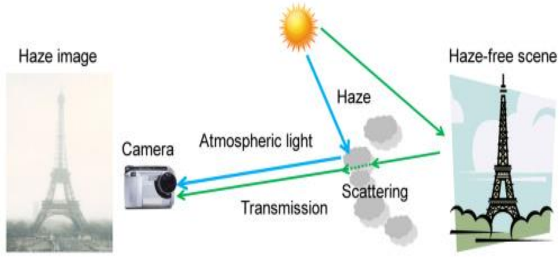

Fig. 1 shows the formation of a Hazy image

The figure shows the formation of haze in the image. The light coming from the object is get attenuated and scattered by the atmospheric particles. This is called attenuation. A small amount of light coming from the illumination source get scattered and coming towards the camera is called the airlight. Koschmieder's model is used estimating the transmission map and the atmospheric light. Airlight and attenuation generally affects the quality of the image.

II. RELATED WORKS

Codruta Orniana Ancuti [1] introduced Multi scale image fusion method. It is a single image dehazing approach. Fusion based technique that employs the inputs and weights that are derived from the hazy image. Two inputs are generated by performing White balancing and Contrast Enhancement in the original hazy image. While preforming contrast enhancement some of the details of image may lost. So, for that proper weight maps are introduced. For both the inputs all weight maps are applied. Then all this weight maps for both the inputs are normalized. Finally, the inputs are weighted by specific weight maps to conserve most important detected features. For normalized weight map a gaussian pyramid is calculated. Then Laplacian pyramid is formed from the gaussian pyramid and is obtained by subtracting extended gaussian pyramid from the levels in the gaussian pyramid. Finally, all these levels are fused in a bottom-up manner.

Jing Zhang [2] introduced a maximum reflectance prior which is a core idea to addressing a haze removal problem from the single nighttime image, even in appearance of non-uniform illumination a model is being proposed. In daytime dehazing, this model is proper. Main Idea is that global atmospheric illumination is assumed only the light in daytime and the scattering and attenuation is identical for each channel. However, in nighttime condition the lights are coming from multiple sources which resulting in abruptly non uniform and multi-coloured illumination.

Therefore, local atmospheric illumination is added to both scattering and attenuation term of the basic hazy imaging model to obtain the nighttime hazy image model. This model

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is entirely different from the previous models. The main is to estimate airlight and transmission for every pixel to recover dehazed image for nighttime. The maximum reflectance prior method calculates the airlight and removes the effect from processing image. Then, calculates the transmission and intensity of changing illumination and remove the haze from the image. Finally, obtained a color balanced and a dehazed image. Some failures cases are there are some color wraps in the regions of grasses and leaves.

Yu Li [3] introduced a haze model for varying light sources and halos. This model consisting of transmission map, airlight and includes halos. The input is a halo image. Then it is divided into halo and halo-free images through an optimization problem. Advance processing is done on the halo-free images. Estimation of transmission map and airlight is the main task in this method. This is an easy and cost-efficient method. But haze-free results are poor compared to other methods.

Manjunath. V [4] Simple but efficient prior which is modification of detail algorithm for single image dehazing. This algorithm is based multiple scattering technique so input image is blurrier. When this method is joined with single image dehazing model, dehazing is very easy and efficient. The algorithm is based on local content is delicate than color and it is applied to larger variety of images. To overcome this problem lot of physical models are used. Imaging in wet weather condition is often damaged by dispersion because of particles in the atmospheric layer like fog, haze etc.

Cosmin Ancuti [5] Proposed a fusion process that is a single image dehazing approach which used for enhancing the nighttime hazy images. Enhancement is performed on the patches of the images and not on the absolute image. The input generation is performed on the original hazy image. First input is calculated using small patch size, by precluding the estimation of atmospheric light from multiple illumination sources. Second input is estimated using large patch sizes and by improving local contrast and it removes notable fraction of the atmospheric light. Third input is discrete Laplacian of the original hazy image which decreases the halo effects from the image. Thus, inputs are generated to enhance the fine details and transferred to the fusion output.

Three weight maps providing larger intenseness in fusion method to establish the regions of high contrast or high saliency. Local contrast weight ensures the amount of variation in each input and is calculated by applying a Laplacian Filter to Luminance of processed image. This is used in applications like tone mapping. Saturation weight map controls the saturation rise in output image.

The main intension of fusion process is to obtain a better haze-free image by blending the generated inputs and the corresponding weight maps that are modelled to sustain the most notable features of the image. The benefit of this method are plainness and computational efficiency. This fusion technique leads to riling artifacts, mostly in locations with rapid transitions in weight maps. Such annoying artifacts can be overcome by using a multi scale Laplacian decomposition.

Sudeep D. Thepade [6] presently fog and haze are becoming a global Challenge, Images captured in this condition is having poor contrast and tainted color. For haze removal widely used methods that is Color attenuation prior haze removal and haze removal with Edge preserving. In this fusion of both these methods are performed and obtain better quality of image compared with other techniques. Color attenuation-based haze removal is a linear method and is based on the difference in the brightness and saturation of pixel in the haze image. For recovering image color attenuation define certain attributes to input. First atmospheric scattering model is calculated. Secondly linear coefficient matrix is estimated and when the coefficient values are obtained, they are used for single hazy images. Thirdly depth and transmission map are calculated. Fourthly the estimation of airlight is performed and depth of the haze image is recovered and allocation of the depth is known. For depicting these distant regions in depth map are used. Finally, the original image without haze is recovered.

In Edge preserving based haze removal it uses filters. The bilateral filter is used for the simplicity and weighted guided filter, guided filter is used to construct guided image. This method consists of three steps. First estimation of transmission map and it provides details of image. Second step is the refinement of transmission map using the guided filter and produced guidance image is alike to input image and the edges are preserved. Finally, the processed image is refined using Laplacian and hence the dehazed image is obtained. The final outputs are fused by taking only the advantages of two methods. Hence obtained an output image with preserves natural color and edges.

Lingke Zeng [7] introduced a multi-scale convolutional NN to determine effectively and different features. Mainly two networks coarse and fine scale networks. The transmission map of the scene is calculated using coarse-scale network and predicts an integrated transmission map on the basis of entire image and the dehazed result is refined locally using fine-scale network.

Sarit Shwartz [8] Outdoor images have poor visibility due to attenuation and scattering during hazy condition. A serious problem is that change in spatially minimization of contrast by the airlight that is scattered by the atmospheric fog particles that are coming to the camera. Currently computer vision techniques shown that images are renumerate for haze, by yielding depth map of image. The main step is such subtraction is a scene recovery of atmospheric light. It is obtained by identifying polarization- filtered image. For the recovery, details of airlight are required. These details are estimated in previous studies by calculating pixels in sky images. The proposed method obtains an approach for the details that is needed for the separation of airlight from calculations that are recovered without vision, then the recovery of contrast, without user contact, and also without reality of sky in frame. So, for dehazing the hazy image, also requires satisfying the attenuation and scattering coefficients.

Ms.S.Archana M.E [9] proposed an adaptive linear model with color attenuation prior details and using depth map to recover the depth details, easily recover the scene radiance by the tropospheric dispersion model and the finely remove the haze from the image. By using the depth map the original image can be restored simply. Obtained a way to construct the scene depth with saturation and brightness of haze image and still there is problem. The scattering coefficient cannot be reinitiated because it is constant in equivalent atmospheric conditions. The existing single image dehazing methods are based on constant inferences and a highly flexible model is required.

Yibo Tan [10] Image dehazing is a challenging task for the existing dehazing techniques for eliminating the block effect and also dealing object that is same to light. For solving this problem, a single image haze removal based on superpixels and markov random field (MRF). This markov random field increases the contrast of the image. Transmittance is estimated using the superpixels and MRF. Proposed technique preserves the edge details successfully. The segmentation is done on the super pixels using simple linear iterative clustering where the artifacts are present. For removing the halo effect correspondence between component pixels and superpixel are selected. For finding the super pixels multivariate gaussian distribution function is used. Superpixels that are not at the structural boundaries have same scene depths and transmission. The revised transmission map is measured using the minimizing energy function. Three terms are used for calculating energy function. First the data term indicates superpixel is having the transmittance. Secondly neighbor term indicates the intensity between the superpixels. Finally, the smooth term indicates the likelihood of neighbor pixels have same transmittance. Data term solves the incorrectly calculated transmittances. The Markov random field method not produce block effect on the edges. MRF preserves the boundary efficiently.

III. CONCLUSION

Dehazing methods have become useful in many computer vision and image processing application like underwater imaging, video surveillance, image composting, satellite imagery etc. This paper contains an abstract view on various methods proposed in previous years for single image haze removal. Through this survey examined the different types of prior/restoration methods and the optimization approaches for the multi-scale fusion and enhancement of hazy image's quality. This paper presents few papers related to haze removal and dehazing techniques.

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