Edge Collapse-Based Dehazing Algorithm for Visibility Restoration in Real Scenes

[1] M.Gowtham Sethupathi [2]Aleaz bhamani [3]Preethi Priyanka.J[4]Bathini Teja Chandana[5]Athil Moosa
Department Of Computer Science & Engineering, SRM Institute of Science and Technology

Abstract: Images captured in foggy weather conditions often suffer from poor visibility, which will create a lot of impacts on the outdoor computer vision systems, such as video surveillance, intelligent transportation assistance system, remote sensing space cameras and so on. In these things, ancient visibility restoration approaches cannot restore pictures accurately as a result of poor estimation of haze thickness and therefore the persistence of color cast issues that leads due drawbacks in restoration and visibility. A Laplacian-based visibility restoration approach is proposed to effectively solve inadequate haze thickness estimation and alleviate color cast issues. By doing so, a high-quality image with clear visibility and vivid color can be generated to improve the visibility of single input image (with fog or haze), as well as the image's details. Our approach stems from two important statistical observations about haze-free images and the haze itself. First, the famous dark channel prior, statistics of the haze-free outdoor images, can be used to estimate the thickness of the haze; and second, gradient prior law of transmission maps, which is based on dark channel prior. The experimental results show that the proposed approach can effectively improve the visibility and keep the details of fog degraded images in the meanwhile. Experimental results via qualitative and quantitative evaluations demonstrate that the proposed method can dramatically improve images captured during inclement weather conditions and produce results superior to those of other state-of-the-art methods.

Keywords: foggy weather, poor visibility, haze thickness, Laplacian-based, single input image, transmission map, dark channel prior.

I. INTRODUCTION

Signal processing is a discipline in electrical engineering and in mathematics that deals with analysis and processing of analog and digital signals, and deals with storing, filtering, and other operations on signals. These signals include transmission signals, sound or voice signals, image signals, and other signals etc. Out of all these signals, the field that deals with the type of signals for which the input is an image and the output is also an image is done in image processing. It deals with the processing on images. It can be further divided into analog image processing and digital image processing. The digital image processing deals with developing a digital system that performs operations on an digital image. Analog image processing is done on analog signal and processed on two dimensional analog signals. In this type of processing, the image are manipulated by electronic means by varying the electronic signal. Binary image, Grey scale image and Color image are three types of images used in Digital Image Processing. A paired picture is an advanced picture that has just two conceivable esteems for every pixel. Normally the two hues utilized for a twofold picture are highly contrasting however any two hues can be utilized. The shading utilized for the object(s) in the picture is the forefront shading while whatever remains of the picture is the foundation shading. A grayscale Image is advanced picture is a picture in which the estimation of every pixel is a solitary example, that is, it conveys just force data. Pictures of this sort, otherwise called highly contrasting, are made only out of shades of dark (0-255), shifting from black(0) at the weakest force to white(255) at the most grounded. An advanced shading picture is a computerized picture that incorporates shading data for every pixel. Every pixel has a specific esteem which
decides it's showing up shading. This esteem is qualified by three numbers giving the disintegration of the shading in the three essential hues Red, Green and Blue. Any shading unmistakable to human eye can be spoken to thusly. The deterioration of a shading in the three essential hues is evaluated by a number in the vicinity of 0 and 255.

II. LITERATURE SURVEY

A. Adaptive histogram equalizer (AOE) is a computer image processing technique used to improve contrast in images. It differs from ordinary histogram equalization in the respect that the adaptive method computes several histograms, each corresponding to a distinct section of the image, and uses them to redistribute the lightness values of the image. It is therefore suitable for improving the local contrast and enhancing the definitions of edges in each region of an image.

However, AHE has a tendency to overamplify noise in relatively homogeneous regions of an image. A variant of adaptive histogram equalization called contrast limited adaptive histogram equalization (CLAHE) prevents this by limiting the amplification.

B. Gamma Correction and Bayesian Probabilistic Model

The use of random variables, or, additional typically, unknown quantities, to model all sources of uncertainty in applied mathematics models. This conjointly includes uncertainty ensuing from lack of data (see conjointly the aleatoric and epistemological uncertainty). the requirement to work out the previous chance distribution taking into consideration the offered (prior) info. The consecutive use of the Byes' formula: once additional knowledge becomes offered, calculate the posterior distribution mistreatment the Bayes' formula; later, the posterior distribution becomes consequent previous.

For the frequentist a hypothesis may be a proposition (which should be either true or false), so the frequentist chance of a hypothesis is either one or zero. In Bayesian statistics, a chance may be appointed to a hypothesis that may dissent from 0 or 1 if the reality price is unsure.

C. HAZE MODEL

Haze is an atmospheric phenomenon that dims the clarity of observed scene due to particles such as fog, smoke and dust. A Hazy scene is characterized by an important attenuation of color that depends proportionally by distance to the object scenes. The dehazing process is controlled only by some parameters such as atmospheric veil inference, smoothing, restoration and tone mapping. The model of haze is established by following,

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

Where, J(x)– Scene radiance, t(x) – direct transmission, A – Atmospheric Light and I(x) - Intensity of Observed Scene.

D. ATMOSPHERIC MODEL

The term part lightweight are going to be calculable from dark channel of hazy image. it's the brightest 0.1% of pixels at intervals a dark channel and from these one, the best intensity pixels are chosen from RGB planes of hazy image as a part lightweight. The dark channel prior is estimated by minimum filter which applies on input image. It is based on key concept that hazy free images have at least one color channel with low intensity values. It is used to determine the transmission map and it is expressed by

$$J_{dark} = min(min(I(x))$$

Where, min(I(x)) finds minimum value among each point of RGB and second min filter gives minimum of local patch.

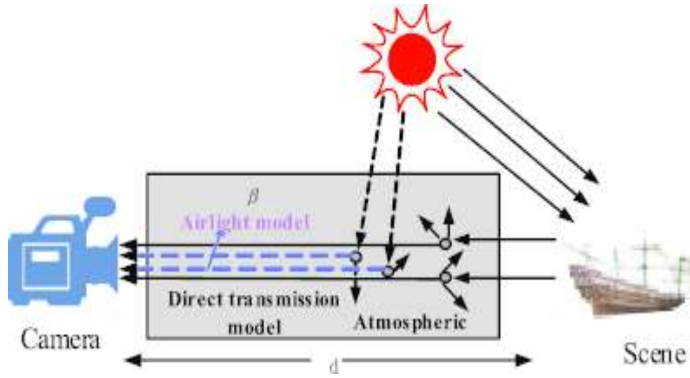

Fig.1 Atmospheric Scattering Model

III. PROPOSED SYSTEM

Accurate extraction of images is a key role factor that influences the performance of computer vision systems. However, in the hazy and foggy weather conditions, image quality severely decreases due to light scattering due to atmospheric particles, and many features of hazy images are covered. It avoids halo impact and light transmission estimation issues. It recovers higher image quality below varied atmospheric phenomenon changes. To get a clear and high resoluted image we use the methodologies which are as follows.

IV. METHODOLOGIES

A. Transmission map Estimation

To recover visibility of an image, transmission map is determined from normalization of hazy image with atmospheric light. It is expressed as following,

$$t(x) = 1 – w (min(min(I(x)/A)))$$

Where, w is set to 0.95, A – Atmospheric light and I(x) – Observed hazy image intensities.

Inner min filter is determined minimum value of color channel at each point and outer min filter finds minimum of local patch centred at each pixel. Transmission map is further utilized to find refined transmission using detailed edge information and it is enhanced by adaptive gamma correction to get better visibility from hazy images.

Fig 2. Transmission Map and Enhanced Map

B. Scene Radiance Recovery

Most existing shape-from-intensity techniques account for only the direct component of light transport. However, this approach requires the projector's illumination to be focused on the entire 3D scene, making it unamenable for depth recovery using projector defocus analysis. For structured light based techniques, the presence of sub-surface scattering and interreflections hinders the detection of the light sheet intersection with the objects. Researchers have used polarization, modulation with a high-frequency illumination pattern and fluorescence to mitigate the adverse effects of global illumination. However, polarization doesn't cut back the consequences of inter-reflections, and therefore the visible light primarily based technique needs submergence the scene during a resorcinol phthalein. Moreover, like any triangulation primarily based technique, structured lighting suffers from the presence of occlusions in complicated scenes. Depth from camera focus (DFF)and depth from camera defocus (DFD)techniques will figure complete depth maps1 , however they have faith in scene texture for correct scene recovery. we tend to use a co-located camera-projector setup for knowledge acquisition. victimization this setup prevents shadows because of occlusions, facultative recovery of complete, hole-free depth-maps. Also, our techniques will handle scenes with or while not textures.

C. Visibility Restoration

A novel DCP-based visibility restoration technique that exploits the advantages of the proposed haze thickness estimation (HTE) module and the proposed image visibility restoration (IVR) module and combines them in order to effectively overcome color cast problems and insufficient estimation of haze thickness. In contrast with traditional DCP based techniques, the proposed technique is built on a Laplacian strategy. Based on this strategy, the proposed method is able to more effectively produce a haze-free image than can the traditional DCP-based techniques. The following are the key features of our proposed method.

First, the proposed HTE module is used to avoid insufficient estimation of haze thickness in real world sandstorm conditions. This module is based on the Laplacian-based gamma correction technique and can effectively estimate the thickness of haze formation, which subsequently refines the transmission map. After haze thickness is effectively calculated in the proposed HTE module, the proposed IVR module is applied via Laplacian-based white patch-Retinex technique to effectively recover true scene colors. Hence, a haze-free image can be effectively generated by the proposed method.

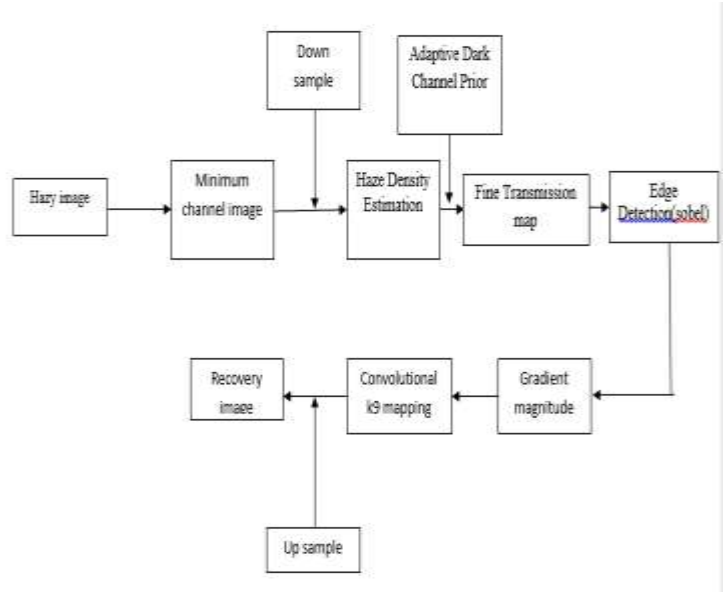

Fig. 3 Block Diagram

D. DOG Pyramid Generation

The SIFT formula transforms a picture into a group of native feature vectors. every of those feature vectors are invariant to any scaling, rotation or translation of the image. The invariant options extracted from pictures will be accustomed perform reliable matching between completely different views of associate degree object or scene. SIFT feature extraction process involves steps such as difference of Gaussian pyramid creation, Extrema detection, Key points Elimination, Orientation assignment and key points localization. Minima or maxima of DOG values compared with local neighborhood helps to find extrema and it yields key points.

V. RESULTS AND DISCUSSION

To test the performance of the proposed method, numerous experiments were conducted. All of the algorithms are implemented in the MATLAB R2014 environment on a DELL notebook computer with the processor i7-5500U @2.4 GHz with 8GB RAM. Hazy images for the experiments were classics in the field and selected from well-known literature sources. They cover city street scenes, natural scenery, aerial images, long-shot scenery, and close-shot scenery. Some of the experimental results are shown in Fig. 11, including a total of eight groups of experimental images with the names 'Hong Kong', 'House', 'Building', 'New York', 'Hill', 'Stadium', 'Trees', and 'Road'. For each group, the first row is the original hazy image, and the second is the haze-free image. The figure shows that using the proposed method, the images—regardless of whether they had marked or gentle changes of field depth or whether they were color or gray images—obtained restored results with natural color and clear details under all of the different conditions. This feasibility and effectiveness of the transmission map estimation shows that the method has strong robustness.

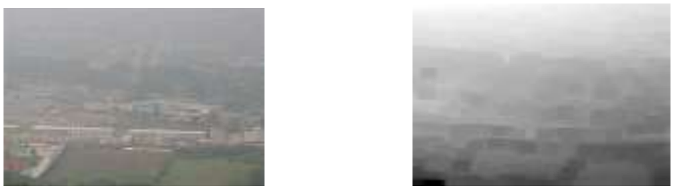

Fig.4 Input hazy and dark channel

VI. CONCLUSION

In this paper, we have proposed a new approach i.e. Laplacian based visibility to restore the haziness of the images and estimate the color forged issues occurred due to adequate change in thickness. By doing so, a high-quality image with clear visibility and vivid color can be generated to improve the visibility of single input image (with fog or haze), as well as the image's details. First, the famous dark channel prior, a statistic of the haze-free outdoor images, can be used to estimate the thickness of the haze; and second, gradient prior law of transmission maps, which is based on dark channel prior. The experimental results show that the proposed approach can effectively improve the visibility and keep the details of fog degraded images in the meanwhile. Experimental results via qualitative and quantitative evaluations demonstrate that the proposed method can dramatically improve images captured during inclement weather conditions and produce results superior to those of other state-of-the-art methods.

VII.REFERENCES

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