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AN IN-DEPTH ANALYSIS OF PREVIOUS-BASED DARK CHANNEL IMAGE DEHAZING

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ABSTRACT Photos and videos taken in bad weather have low contrast and clarity because of the pollutants and particles in the air. The pictures have messed up colors and not enough contrast. Images must be free of haze in order to be clear. Object tracking and video monitoring can both benefit from ways to improve and clear up underwater images. A lot of focus has been paid to single-image DCP dehazing. These methods include the following steps: 1. Making the dark channel; 2. Planning the light and waves in the sky; 3. Making the dark channel. After the transmission map gets better, the dehaze picture is put back together. This article talks about all the stages of DCP, even the more advanced ones, like IDCP, IDCP with a guided filter, and DCP with histogram normalization. How does DCP-based dehazing work? Read this study to find out.

***Index Terms* -** Dark channel prior, dehazing, airlight, transmission map, dehazed image construction, LOS.

1.INTRODUCTION

Outdoor photos in bad weather look worse due to airborne particles. Smoke, dust, wet snow, water drops, and other air contaminants worsen the image's colors and contrast. Each particle is less than 1000 m apart.

Natural haze is air particles that obscure the sky. Airlight and direct absorption generate most haze. Airlight from line of sight and other sources makes a picture whiter. Attenuation, the second factor, reduces visual intensity. The picture darkened due to this decline. How spreading looks in photos depends on object distance from the camera. As distance increases, scattering worsens, blurring visuals. This degrades image spatial variation.

For this reason, computer vision systems must highlight image components and increase visual effects. "Defogging" and "haze removal" are additional names for photo cleaning. Using specific approaches to reduce haze disturbance is the major goal. These methods produce good visuals and data. The photo improvement dehazing method removes unnecessary visual effects. This removes noise and improves contrast differently than previous methods. The haze is created by the distance between the acquisition equipment and the object, and its density affects picture pixel performance.

Dehazing is difficult since picture quality decreases with space and scene depth. Basic contrast-boosting methods like linear mapping, Ahistogram equalization, and gamma correction ignore spatial correlations and focus on pixel values.

After "video dehazing" the movie has no haze in any frame or image. It entails removing frames so the dehazing algorithm can work on them and then assembling them to generate the final video. Video specs must be checked before employing the suggested dehazing process, and outcomes must be monitored in order. The first study took varied quantities of images of the same scene in varying weather. Polarization, depth map, and numerous photographs of the same scene were employed with these pictures.

Tan et al. used two earlier theories to dehaze a single image: airlight changes are smooth, and fog has less contrast than clear day. This process works for black-and-white and color photos. Rapid depth changes generate halo effects, making colors excessively intense.

R. FATTAL used independent component

analysis and a markov random field model to replicate the clear picture. He checked surface albedo and medium transmission with these techniques. This method works if there is adequate color information. Image restoration fails when the initial ideas are erroneous, like when the picture has a lot of haze.

In their new previous-DCP (dark channel prior) method, he and his colleagues assumed that some color channel pixels were very faint. This approach chooses the cloud-free portion of the image. The transfer map evaluation is correct. This method may not work for brighter elements of the picture like the sky, water, or white.

C.O. Ancuti, C.Ancuti, and C. Hermans discuss clearing a single fuzzy picture. A single per pixel and per-pixel fuzzy patches create a picture that is opposite the original. This approach evaluates airlight contrast and transmission map well. This approach loses picture edges but processes faster and better.

Using the dark channel prior (DCP) and histogram definition, Xiaoyan Yuan et al. improved haze removal. An image with low contrast and a huge background was cleaned up using the DCP method to create an amorphous image. After changing brightness and contrast with the DCP approach, he rebuilds the histogram to improve the image.

Anupama, Nidhi Singh, and Lavi Tyagi invented a mechanism to remove haze from a solid color image. IDCP and histogram equalization were used in this hybrid dehazing approach. To eliminate color image haze, they developed HDCP. A weighted guided filter removes noise after histogram normalization and a superior dark channel prior. Motivated by its success, this technique tracks objects and identifies traffic signs. Haze-free images are crisp and contrasty.

The contrast limited adaptive histogram equalization (CLACHE) approach was developed by Xu et al. They concluded that ancient photos lack contrast. Many dehazing review papers discuss improvement and restoration methods.

2.BACKGROUND

Haze models and dark channel prior-based approach algorithms were used to explain haze and its removal.

HAZE MODEL

Figure 1 exhibits hazy picture evolution. Air light and direct absorption create haze.

Airlight + Attenuation = Haze

As shown mathematically:

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

When looking at a photograph, t(x) shows how much light gets to the camera without scattering, and A shows atmospheric brightness. X is the picture's coordinates, and I is the digital camera's fuzzy image. T(x) is the transmission map and J the clear image.

The transmission map is affected by the atmosphere's scattering coefficient and the scene's light depth.

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

Clear weather means no fog, hence t(x) = 1. Because the air scattering coefficient is 0.

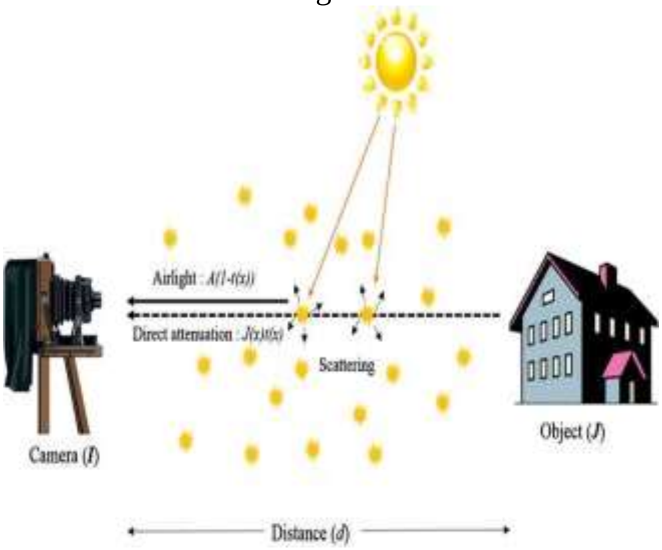

Fig1. hazy picture forms.

I(x) = J(x) The image is clear. In Equation 1, direct absorption is j(x)*t(x), which decreases, and air light is A(1-t(x)), which increases with scene depth.

Guess A and t and use fuzzy image I to find clear image J.

$$J(x)=\frac{I(x)-A}{t(x)}+A \quad (3)$$

BASIC ALGORITHM FOR DCP BASED DEHAZING METHODS

Figure 2 depicts the key DCP-based single picture dehazing procedures. Create the dark channel, guess the transmission map and outdoor light, refine the transmission map, and dehaze the image.

Dark Channel Construction

The local patch (x) size is crucial to creating the black channel from a blurry picture. It assumes that every picture patch contains at least one color channel with bright but not very brilliant pixels. Shadowy routes are described as

$$J^{dark}(x) = \min_{y \in \Omega(x)} (\min_{c \in \{r,g,b\}} J^{C}(y)) \quad (4)$$

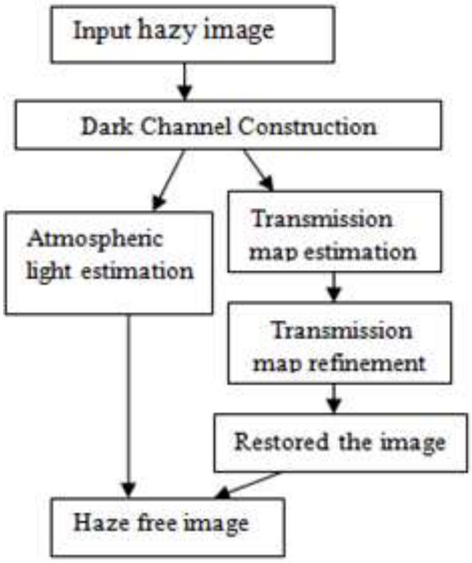

Fig2 Simple block diagram of DCP-based dehazing.

JC(y) is the color channel intensity (c, r, g, b) in the RGB picture, and (x) is a patch at pixel x.

Zhang introduced the min operator, however the median operator can find the dark channel. The process is difficult.Trying to guess broadcast map

Transmission Map Estimation

For transmission map estimation divide the eq.(1) by A^c as given in a local patch:

$$\min_{y \in \Omega(x)} \frac{Ic(y)}{Ac} = t(x) \min_{y \in \Omega(x)} \frac{Ic(y)}{Ac} + (1 - t(x)) \quad (5)$$

It is assumed that in local patch Ω(x) transmission is constant as t(x) now after applying three color channels:

$$\min_{y \in \Omega(x)} (\min_c \frac{Ic(y)}{Ac}) = t(x) \min_{y \in \Omega(x)} (\min_c \frac{Ic(y)}{Ac}) + (1 - t(x)) \quad (6) \quad \text{where } c \in \{r,g,b\}$$

J(x) haze free image so dark channel value becomes zero, and then transmission map can be written as:

$$t(x) = 1 - \min_{y \in \Omega(x)} (\min_c \frac{Ic(y)}{Ac}) \quad (7)$$

For better visibility in the dehazed image a constant

ω is added in the Eq.7 and it can be now presented as:

$$t(x) = 1 - \omega \min_{y \in \Omega(x)} (\min_c \frac{Ic(y)}{Ac}) \quad (8)$$

Where $0 < \omega < 1$

Atmospheric Light Estimation

The transmission map estimated by Eq. 7 depends on natural light since most earlier approaches employed the p% brightest pixels in the picture. DCP-based dehazing uses 0.1 to 0.2 p.

You can estimate atmospheric light by entropy or strength. In a fuzzy picture, D(x) approaches infinity and t(x) = zero when A is close to the sky color.

Transmission Map Refinement

- Finetuning t(x) is crucial since the transmission map accuracy determines the dehazed image quality. If the transmission map estimate is inaccurate, blocking and false pictures will occur. Some filters improved it.
- Fuzzy images increase transmission maps as leading images in cross bilateral and directed filters. Gaussian and bilateral filters don't behave this way, even for soft matting. T(x) represents an improved transmission map. We can compare refinement approaches as follows:
- Time complexity-guided filters get the best results.
- From Cr to Sm to Gi Bi.

Dehazed Image Construction

The improved transmission map t(x) in the haze model Eq. 3 can be changed to recreate the dehazed image:

$$J(x) = \frac{I(x) - A}{\max(t^{\wedge}(x), to)} + A \quad (9)$$

In Eq. 9, the denominator must always be greater than 0. Choose a constant between 0.1 and 0.75 to avoid this.

3.DCP BASED DEHAZING TECHNIQUES

DARK CHANNEL METHOD

Assuming at least one color channel in a section of an image has dark pixels clears up a single image.

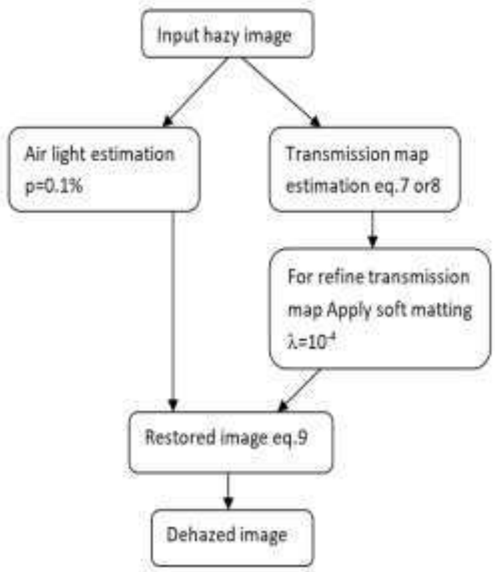

Fig 3: DCP algorithm block diagram.

Merits:

- It works well for changing situations as a single-picture fog removal approach, and the transmission map estimation is good.

Demerits:

- ➢ Halos appear in the final shot.
- ➢ Soft matting installation takes time.
- ➢ Winter landscapes and automobile headlights are too white for this method.

IMPROVED DARK CHANNEL PRIOR

This approach beats Yan Wang's 2010 DCP[18].This method uses bilateral screens instead of soft matting. For air light calculation, the patch size is extended to 31x31.

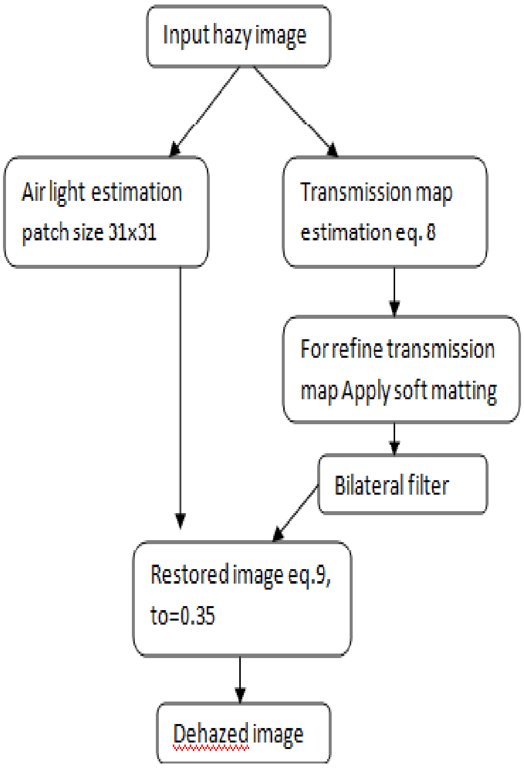

Fig 4: IDCP algorithm block diagram

Merits:

- ➢ Air Light guessed correctly.
- ➢ Time is simplified by not using soft flooring.
- ➢ The bilateral filter corrects transmission map color errors.

Demerits:

- ➢ Transmission map estimation is inaccurate.
- ➢ emits some radiance.

IMPROVED DCP USING GUIDED FILTER

The directed filter smooths and maintains edges. For local linear filter output, utilize the guiding picture. The input picture or another picture could be the guiding picture.

Halo effects are DCP and IDCP's biggest drawback. This approach eliminates those impacts by modifying transmission maps with guided filters.

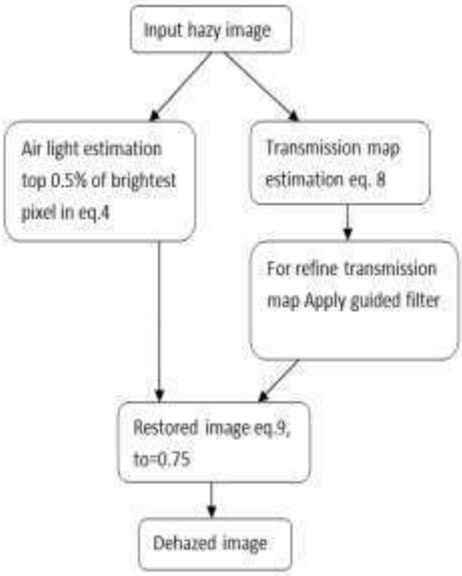

Fig 5: IDCP directed filter algorithm block diagram.

Merits:

- ➢ Refined the t(x) search with a hazy image to get a map as clear as the photo.
- ➢ Guided filter works faster than bidirectional filter and soft matting.
- ➢ Successfully remove halo effects..

Demerits:

Air light estimation is poor in the recovered image, which has minimal contrast.

DCP WITH HISTOGRAM SPECIFICATION

When the source image contains a lot of background and low contrast, the DCP with histogram specification technique recovers greater contrast.

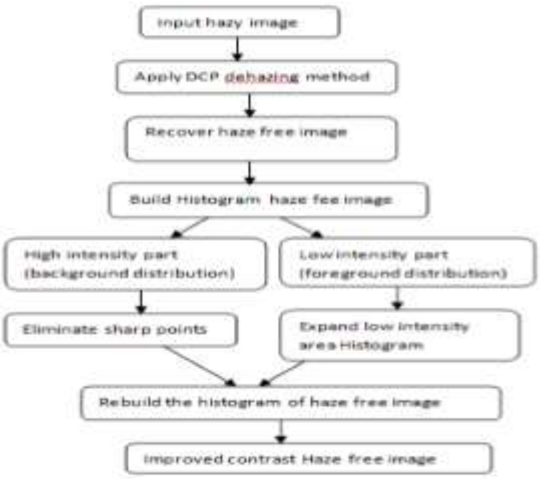

Fig 6: The DCP histogram specification algorithm is block diagrammed.

Merits:

Haze-free images have more contrast than DCP images, and only the area of interest changes intensity. Demerits:

Now more than ever, time matters.

This strategy doesn't work for dark backdrop photos.

4.CONCLUSIONS

This article reviews a powerful DCP-based dehazing algorithm. It constructs a dark channel, calculates the atmospheric light and transmission map, enhances it, and produces a haze-free image. Following the benefits and cons of each strategy, we recommend IDCP with a guided filter. Guided filters for IDCP work well. Guided filters are slower and use more memory. We will aim to reduce working time, improve contrast gain, and optimize memory utilization in the future.

REFERENCES

1. S. G. Narasimhan,Y. Y. Schechner and S. K. Nayar. 2001. Instant dehazing of images using polarization. IEEE Computer SocietyConf. Computer Vision and Pattern Recognition, USA. 325-332.
2. R.T.Tan.2008.Visibility in bad weather from a single image. IEEE Conf. Computer Vision and Pattern Recognition, Anchorage,AK, USA. R.Fattal. 2008.Single image dehazing.ACM Trans. Graph. (TOG).27(3).Article ID 72.
3. K. M. He, J. Sun, and X. O. Tang.2009.Single image haze removal using dark channel prior. IEEE Conf. Computer Vision andPattern Recognition, New York, USA.1956-1963.
4. C.O. Ancuti, C.Hermans, and P. Bekaert. A fast semi inverse approach to detect and remove the haze from a single hazy image.Asian Conf. Comput.Vis. (ACCV), Issue No.2.501-514.
5. Z. Y. Xu, X. M. Liu, and N. Ji.2009.Fog removal from color images using contrast limited adaptive histogram equalization. 2ndIEEE Int. Congress on Image and Signal Processing, Tianjin, China.1-5.
6. SC Huang, BH Chen, WJ Wang.2014.Visibility restoration of single hazy images captured in real-world weather conditions.IEEE Trans. Circuits Sys. Video Tech. 24.1814–1824.
7. H Xu, J Guo, Q Liu, L Ye.2012. Fast image dehazing using improved dark channel prior. International Conference on Information Science and Technology.663–667.
8. S Jeong, S Lee.2013.The single image dehazing based on efficient transmission estimation. IEEE International Conference on Consumer Electronics (ICCE).376–377.V.Saminadan, Aishwarya, Manimegalai, Nivedhitha, Subhapriya.2015.Efficient Image Dehazing based on Pixel Based Dark channel prior and guided filter. IEEE ICCSP conference.1925-1927.YQ Zhang, Y Ding, JS Xiao, J Liu, Z Guo.2012.Visibility enhancement using an image filtering approach. EURASIP J. Adv.Signal Process.