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A Review on DCP and CAP Based Dehazing Techniques-A Literature Survey

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Abstract: Dehazing is the process of removing atmospheric suspended particles like haze from images and it plays a dominant role in many image processing applications. The visibility of outdoor images is often degraded due to the presence of haze, fog, sandstorms, and so on. Poor visibility caused by atmospheric phenomena causes failure in image processing applications. Haze removal also known as dehazing refers to different methods that aim to reduce or remove the image degradation that have occurred while the digital image was being obtained during inclement weather conditions. This paper mainly focuses on prior based dehazing techniques. Dark channel prior based dehazing and colour attenuation prior based dehazing are the two existing prior based dehazing technique. This paper provides a comparison between various Dark Channel Prior based dehazing techniques, gives a brief idea about Colour Attenuation Prior based dehazing and also provides an idea about an advanced colour attenuation prior based dehazing technique.

Keywords: Dehazing, Dark Channel Prior,Colour Attenuation Prior

I. INTRODUCTION

Haze removal or dehazing is highly required in computer vision applications and in computational photography. Removing the haze layer from the input hazy image can significantly increase the visibility of the scene. The haze free image is basically visually pleasing in nature. Many vision algorithms suffer from low contrast scene radiance. In image processing area dehazing is one of the challenging problem or task as because the haze is dependent on unknown depth. For a single input hazy image the haze removal problem is under constrained problem. Haze is an atmospheric phenomena where dust, smoke and other dry particles obscure the clarity of the sky.

The process of removing haze from images is called dehazing. Haze is the atmospheric phenomena that leads to the degradation of outdoor images and blurring of both colour and contrast images. The bad weather conditions may demeans the quality of the images of outdoor scene.

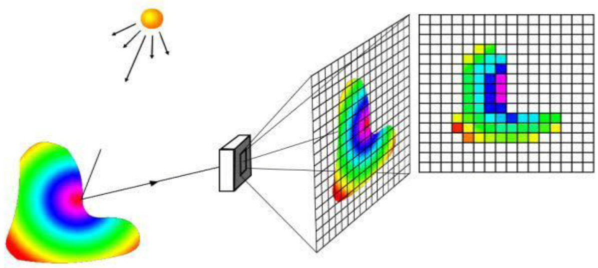

Figure 1: Imaging during Sunny weather

Imaging during sunny weather as shown in Figure 1 results in a visually clear image due to the absence of atmospheric suspended particles like haze,fog etc.

Imaging during Hazy weather as shown in Figure 2 results in a visually unclear image due to the presence of atmospheric suspended particles like haze,fog etc.

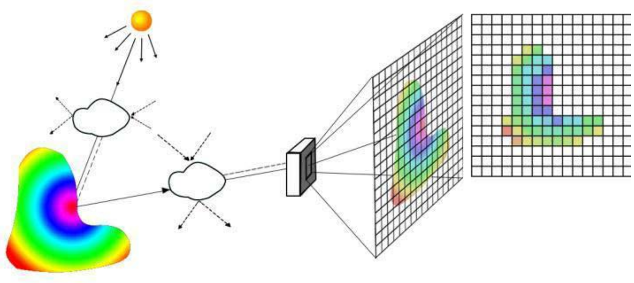

Figure 2: Imaging during Hazy weather

The remainder of this paper is organized as follows: Section II gives a brief idea about Dark Channel Prior Based Dehazing [1] Related Works gives a comparative study of existing Dark Channel Prior Based Dehazing Techniques.Section III gives a brief idea about Colour Attenuation Prior based dehazing [2] and Section IV.gives a brief conclusion .

II. DARK CHANNEL PROR BASED DEHAZING

The dark channel prior [1] is based on the statistics of outdoor haze-free images. In most of the non-sky patches, at least one color channel (RGB) has very low intensity at some pixels (called dark pixels). These dark pixels provide the estimation of haze transmission in the image. This approach is physically valid and gives a better dehazing result. When the scene objects are similar to the air light then it is invalid. The dark channel prior [1] is based on the statistics of haze-free outdoor images. In case of local regions which do not cover the sky, it is very often that some pixels (called dark pixels) have very low intensity in at least one colour (rgb) channel. In the hazy image, the intensity of these dark pixels in that channel is mainly contributed by the airlight. Therefore, these dark pixels directly provides accurate estimation of the haze transmission. Combination of a haze imaging model and a soft matting interpolation method results in a high quality haze-free image and produce a good depth map (up to a scale).

Applying DCP [1] into the haze imaging model, single image haze removal becomes simpler and more effective. Since the dark channel prior is a kind of statistic, it may not work for some particular images. When the scene objects are inherently similar to the atmospheric light and no shadow is cast on them, the dark channel prior is invalid.

DCP algorithms work efficiently even when haze is dense. It's only one drawback is the sky region. It fails to remove haze in the sky region. Edge collapse based dark channel dehazing[4] method uses Koschmieder's model[3] . In terms of hazy image, the DCP algorithm is efficient because it is very fast, and easy to implement.

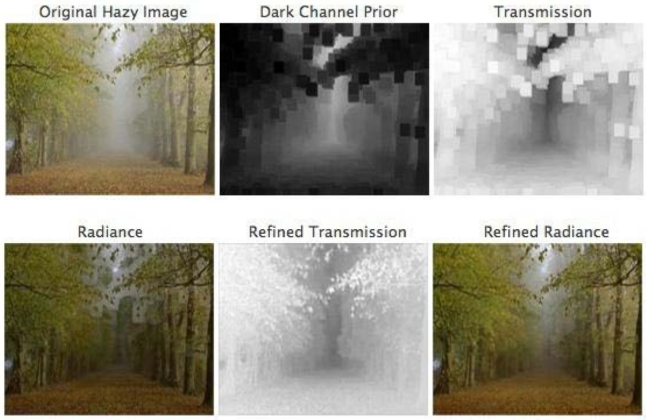

Figure 3: Dark Channel Prior Based Dehazing Process

Figure 3 shows Dark Channel Dehazing Process,First of all dark channel prior of image is estimated and then transmission map is generated. This Transmission map is refined and finally after a few more intermediate steps a dehazed image will be obtained .

III. RELATED WORKS

A different Dark Channel Prior based dehazing methods are given below and the

- Simple dark channel prior based dehazing [1]
- Improved dark channel prior based dehazing [5]
- Improved dark channel prior based dehazing by guided filter[6]
- Dark channel prior based dehazing by histogram specification[7]
- Dark channel prior based dehazing by edge collapse algorithm[4]

A comparative study of this methods are given below in TableI

Table I. Comparative Study of Different DCP based Dehazing Techniques

DARK CHANNEL PRIOR BASED DEHAZING	***ADVANTAGES***	***DISADVANTAGES***
Dark Channel Prior	• Estimates the haze thickness • Transmission map is estimated accurately	• Air light estimation is poor • It produces some Halo effects on the resultant images
Improved Dark Channel Prior	• Estimation of air light is accurate and Less computation time Is required	• It produces Halo effects
IDCP using Guided Filter	• In this method Halo effects is removed efficiently. • Refining of transmission map is done by guided filter so it gives good result.	• Estimation of air light is not done accurately. • It doesn't improve the contrast.
DCP with Histogram Specification	• Haze is removed efficiently from the large background and low contrast images	• This method gives poor contrast image.
DCP Based On Edge collapse based algorithm	• Removes thick haze particles efficiently	• Contrast enhancement is not efficient

From the comparative study we can see that DCP based on Edge Collapse Algorithm[4] is more efficient in terms of removing thick haze particles other DCP based dehazing techniques gives good dehazing results but fails to dehaze heavy haze particles efficiently.

IV. COLOUR ATTENUATION PRIOR BASED DEHAZING

Colour attenuation prior [2] is a prior that is entirely based on the difference between the brightness and the saturation of the pixels within the hazy image. Repairs transmission map and restores visibility. By creating a linear model for modelling the scene depth of the hazy image under this novel prior and learning the parameters of the model by using a supervised learning method, the depth information can be recovered .The main goal is haze removal by depth map estimation. The advantages of this prior is as follows

- This simple and powerful prior can help to create a linear model for the scene depth of the hazy image.
- The bridge between the hazy image and its corresponding depth map is built effectively.
- With the recovered depth information it is possible to remove the haze from the single hazy image easily.

As very small information about the scene structure is available it is very difficult to detect or remove the haze from a distinct image in computer vision, In spite of this, the human brain can quickly recognize the hazy area from the natural scenery without any extra information. The denser the haze is, the stronger the influence of the air light would be. Guided filter [8] is used for refinement. Since the concentration of the haze increases along with the change of the scene depth in general, make an assumption that the depth of the scene is positively correlated with the concentration of the haze .

Figure 4: Colour Attenuation Prior Based Dehazing Process

Figure4 gives a brief idea about overall Colour Attenuation Prior based dehazing[2] process.To detect and dehaze haze from a single image is a challenging task in computer vision, because little information about the scene structure is only available. In spite of this, the human brain can quickly identify the hazy area from the image without any additional information. The brightness and the saturation of pixels in a hazy image vary sharply along with the change of the haze concentration. In a haze-free region, the saturation of the scene will be high, the brightness will be moderate and the difference between the brightness and the saturation will be almost close to zero.

V. CONCLUSION

Colour attenuation prior based dehazing[2] gives a better dehazing results and enhances the contrast of the image very well compared to other prior based dehazing techniques and this dehazing technique can be enhanced by adding a edge attenuation operation so a better dehazing result can be obtained. Dehazing algorithms is very useful for many computer vision applications. It is found that most of the existing researchers have neglected many issues; i.e. technique accurate for different kind of circumstances. Poor visibility caused by atmospheric suspended particles like haze,fog,dust etc causes failure in image processing and computer vision applications, such as outdoor object recognition systems, obstacle detection systems, video surveillance systems, and intelligent transportation systems. In order to solve this problem, visibility restoration techniques have been developed and plays a key role in many computer vision applications that operate in various weather conditions.

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