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A Review on Road Scene Image Enhancement

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ABSTRACT

Enhancement plays an important role in digital image processing.The visibility of images of open air road scenes becomes degraded when captured in severe climate conditions. Drivers frequently turn on the headlights of their vehicles and streetlights are regularly actuated, bringing about confined light sources in images of road scenes in these conditions. Furthermore, dust storms are additionally climate occasions that are regularly experienced when driving in a few districts. A novel and effective haze removal approach to cure these issues created by confined light sources and color shifts, which subsequently accomplishes better restoration results for single hazy images. Poor visibility degrades quality and performance of computer vision algorithms for smart transportation frameworks, for example, traveling vehicle data recorders and traffic surveillance systems, activity observation frameworks which must operate under a wide range of weather conditions. Another issue is that the captured foggy road scene images contains confined light sources or shading movement issues because of dust storm conditions. Movement detection and Darkness are also problems in the captured images. The goal of this work is to enhance the road scene images using different filters and enhancement techniques. The distinctive sorts of parameters are figured that are PSNR, MD, MSE and Processing Speeds.

Keywords: PSNR, MD, images, HE, BBHE, DPC,RSWHE.

I. INTRODUCTION

Visibility in road images can be debased because of normal air conditions, for example, dimness, mist, and dust storms. This visibility corruption is because of the ingestion and dissipating of light by barometrical particles. Road image debasement can bring about issues for wise transportation frameworks, for example, voyaging vehicle information recorders and movement observation frameworks, which must work under an extensive variety of climate conditions [1].The amount of absorption and scattering depends on the depth of the scene between a traffic camera and a scene point; therefore, scene depth information is important for recovering scene radiance in images of hazy environments. Movement scene characterization is a developing subject with extensive significance in the field of wise transportation frameworks [6]. With the expanded accessibility of cameras in vehicles (either on cell phones or as inserted equipment in sumptuous auto models) there are more potential outcomes for improving basic wise transportation undertakings. Fleet management systems are used to track the status of fleets of vehicles belonging to various kinds of companies e.g. taxi, delivery, cargo transport [8]. They utilize GPS sensors to track the vehicle's area, yet have little data about the vehicle's surroundings [5]. Some useful information about the vehicle's surroundings can be inferred by using a camera to record images from the driver's perspective, and then solving a classification problem to detect interesting types of traffic scenes and scenarios [7].For example, this approach can be used to identify traffic jams, or to differentiate open road environments from urban/rural roads or tunnels [2].

Image classification in general is a common topic in computer vision, extensively researched in great number of papers. Active research focuses mainly on recognizing images in a large number of diverse classes [1]. This enables a simple and meaningful comparison of state-of-the-art methods applied on various domains. However, the scene radiance recovered via the dark-channel-prior-based techniques is usually accompanied by the generation of serious artifacts when the captured hazy road image contains localized light sources or color-shift problems due to sandstorm conditions [10]. This can be problematic for many common road scenarios. For example, in inclement weather conditions, the drivers generally turn on headlights when they are driving in order to improve visual perception, and streetlamps are lit for similar reasons [9]. The techniques based on the dark channel prior cannot produce satisfactory restoration results when presented with these situations.

A novel haze removal approach by which to avoid the generation of serious artifacts by the conjunctive utilization of the proposed hybrid dark channel prior (HDCP) module, color analysis (CA) module, visibility recovery (VR) module, Histogram Equalization(HE), Recursive sub weighing Histogram Equalization(RSWHE) . The proposed technique can effectively conceal localized light sources and restrain the formation of color shifts when the captured road image contains localized light sources or color-shift problems.

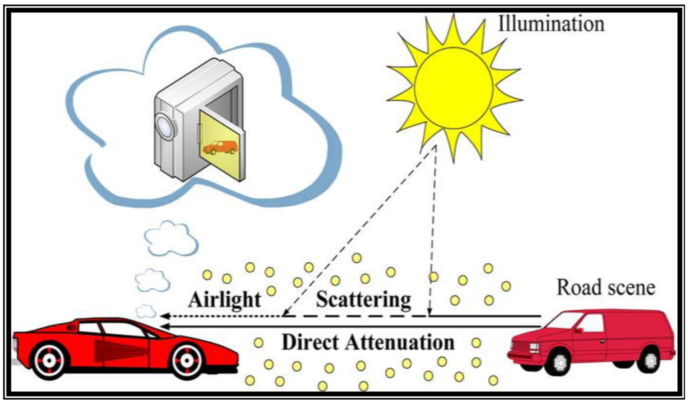

Figure 1. Pictorial description of hazy image acquisition via the optical model [1]

II. METHODS AND MATERIAL

A. Literature Survey

Previous Research work on **"Road Scenes Images Enhancement"** in the literature survey was studied which helped to complete work and enhance knowledge. On the basis of studying various papers some of them are given below:

Shih-Chia Huang et.al [2014] have presented the visibility of images of outdoor road scenes will generally become degraded when captured during inclement weather conditions. Drivers often turn on the headlights of their vehicles and streetlights are often activated, resulting in localized light sources in images capturing road scenes in these conditions. Additionally, sandstorms are also weather events that are commonly encountered when driving in some regions. In sandstorms, atmospheric sand has a propensity to irregularly absorb specific portions of a spectrum, thereby causing color-shift problems in the captured image. Traditional state-of-the-art restoration techniques are unable to effectively cope with these hazy road images that feature localized light sources or color-shift problems. In response, a novel and effective haze removal approach to remedy problems caused by localized light sources and color shifts, which thereby achieves superior restoration results for single hazy images. The performance of the proposed method has been proven through quantitative and qualitative evaluations. [1].

Giri Nandan et.al [2014] In this paper various enhancement techniques are discussed and compared. Various methods for image resolution enhancement had been discussed which shows we can enhance the images on color scale by using different techniques nowadays. Different areas in which image enhancement can be used are compared in this paper. We will discuss the methods which can enhance the resolution of MR images, images taken by regular cameras, Built-in camera image of a Mobile phone, vehicle camera images and an aerial image. [6]

Ashamdeep Singh et.al [2013] Digital images are the most common application of now day's world. In almost every era of life and technology, the digital images are playing their roles. The problem with images is that, their quality depends on a number of other factors like lighting at the image capturing location, proficiency of the operator, and noise. A lot of techniques have been suggested earlier for the enhancement of the color images which works on histogram of the image or on some particular region. Region based techniques using texture analysis are simple and more effective as they work according to the specified regions of the image. Seed selection is an optimal method for initiate any spatial enhancement. This paper suggests a new hybrid approach for enhancement of the digital images. The suggested technique is based on region growing segmentation and works adaptively for enhancement of the image. Further, the technique is seed dependent so selection of seed is very important in this algorithm. A seed chosen in darker regions will give better results than the seed chosen in brighter region, because it is assumed that user will require enhancing the darker portions of the image. In this paper the process of color image enhancement uses three modules. Initial seed selection is our first module. Our second module is region growing it is used to segment the image based on seed regions. The third and last module is region merging and used morphological operations as texture analysis.

Ajay Raghavan et.al [2012] have presented Unattended camera devices are increasingly being used in various intelligent transportation systems (ITS) for applications such as surveillance, toll collection, and photo enforcement. In these fielded systems, a variety of factors can cause camera obstructions and persistent view changes that may adversely affect their performance. Examples include camera misalignment, intentional blockage resulting from vandalism, and natural elements causing obstruction, such as foliage growing into the scene and ice forming on the porthole. In addition, other persistent view changes resulting from new scene elements of interest being captured, such as stalled cars, suspicious packages, etc. might warrant alarms. Since these systems are often unattended, it is often important to automatically detect such incidents early [3].

Fan-Chieh Cheng et.al [2011] have proposed a novel background subtraction approach in order to accurately detect moving objects. The method involves three important proposed modules: a block alarm module, a background modeling module, and an object extraction module. The block alarm module efficiently checks each block for the presence of either a moving object or background information. This is accomplished by using temporal differencing pixels of the Laplacian distribution model and allows the subsequent background modeling module to process only those blocks that were found to contain background pixels. Next, the background modeling module is employed in order to generate a high-quality adaptive background model using a unique two-stage training procedure and a novel mechanism for recognizing changes in illumination. The overall results show that our proposed Method attains a substantially higher degree of efficacy, outperforming other state-of-the-art methods by Similarity and $F1$ accuracy rates of up to 35.50% and 26.09%, respectively. [4].

Ivan et.al [2010] has studied work deals with multi-label classification of traffic scene images. We introduce a novel labeling scheme for the traffic scene dataset FM2. Each image in the dataset is assigned up to five labels: settlement, road, tunnel, traffic and overpass. They propose representing the images with (i) bag-of-words and (ii) GIST descriptors[2]. The bag-of-words model detects SIFT features in training images, clusters them to form visual words, and then represents each image as a histogram of visual words. On the other hand, the GIST descriptor represents an image by capturing perceptual features meaningful to a human observer, such as naturalness, openness, roughness, etc. compare the two representations by measuring classification They report good classification results for easier class labels (road, F1 = 98% and tunnel, F1 = 94%), and discuss weaker results (overpass, F1 < 50%) that call for use of more advanced methods. [2].

B. Image Enhancement Techniques

i) Optical Model:

In computer vision and pattern analysis, the optical model is widely used to describe the digital camera information of a hazy image under realistic atmospheric conditions in the RGB color space as [1]:

$$I^c(x,y) = J^c(x,y)t(x,y) + A^c(1 - t(x,y)) \quad [1]$$

where $c \in \{r, g, b\}$, $I^c(x, y)$ represents the captured image, $J^c(x, y)$ represents the scene radiance that is the ideal haze free image, A^c represents the atmospheric light, and $t(x, y)$ represents the transmission map describing the portion of the light that arrives at a digital camera without scattering [1]. The first term of (1), i.e., $J^c(x, y)t(x, y)$, represents the direct attenuation describing the decayed scene radiance in the medium. The second term of (1), i.e., $A^c(1 - t(x, y))$, represents the airlight that resulted from the scattered light and leading to the color shifting in the scene.

ii) Dark Prior Channel Technique:

The dark prior channel technique [3] can work well for haze removal in single images that lack localized light sources. However, haze removal by the dark channel prior technique [2] usually results in a seriously underexposed image when the captured scene features localized light source. Correct atmospheric light, the use of a large local patch will result in invariable transmission and thereby leads to the generation of halo effects in the recovered image [11]. In contrast, when the dark channel prior technique [1] uses a small patch size, the recovered image will not exhibit halo effects. In other words, the minimum intensity in such a patch should has a very low value. Formally, for an image J, we define [1]:

$$J^{dark}(\mathbf{x}) = \min_{c\in\{r,g,b\}}\left(\min_{\mathbf{y}\in\Omega(\mathbf{x})}(J^c(\mathbf{y}))\right)$$

where Jc is a color channel of J and Ω(x) is a local patch centered at x. Our observation says that except for the sky region, the intensity of Jdark is low and tends to be zero, if J is a haze-free outdoor image.

iii) Hybrid Dark Channel Prior Technique:

HDCP module can produce a restored image that is not underexposed by using a procedure based on the dark channel prior technique [3]. HDCP technique for haze removal in single images efficiently conceals localized light sources and, consequently, accurately estimates the position of the atmospheric light.

However, localized light will be misjudged as atmospheric light. Hence, we present the HDCP module that ensures correct atmospheric light estimation and the subsequent avoidance of halo effects during the haze removal of single images based on the hybrid dark channel prior technique [13]. This technique will be introduced in the following. To effectively estimate the density of the haze featured by an image, we combine the advantages of small and large patch sizes via different weights [10]. In addition, we use the large patch size to acquire the correct atmospheric light during the implementation of the hybrid dark channel prior technique. HDCP module can provide effective transmission map estimation and thereby avoids the production of artifact effects in the restored image [9].

iv) Color Analysis Model:

The particles of sand in the atmosphere caused by sandstorms absorb specific portions of the color spectrum [8]. This phenomenon leads to color shifts in images captured during such conditions, resulting in different color channel distributions [15]. To recover from scene radiance problem, we propose the CA module that is based on the gray world assumption. The gray world assumption relies on the notion that average intensities should be equal in each RGB color channel for a typical image [14].

v) Visibility Recovery Technique:

The VR module combines the information obtained by the HDCP and CA modules to avoid the generation of serious artifact effects and thus obtain a high-quality haze-free image regardless of weather conditions [3].It is used to remove haze, fog, mist [12].It uses visibility restorer to improve the visibility of the input image.

vi) Histogram Equalization Technique:

HE is most widely used method for image contrast enhancement.

It uses images cumulative distributive function to improve image contrast. But it has a problem of mean shift in which the mean brightness of input image is different from output image. According to [6], HE introduces two types of artifacts in which over-enhancement is done for the image with more frequent gray levels; and loss of contrast for the image regions with less frequent gray-levels. Consider the input image **X**. Based on the histogram H(**X**), the probability density function (PDF) of the image is calculated and it finds cumulative distributive function (CDF)[14].

vi) Brightness-Preserving Bi Histogram Equalization:

BBHE copes up with the mean shift problem encountered in histogram equalization works by segmenting the input histogram into two sub-histograms. BBHE first segments the input histogram and then executes each segmented sub-histogram independently. During segmentation it determines threshold for histogram segmentation in order to minimize the brightness difference between the input image and output image[14].

BBHE first decomposes the input histogram H(**X**) into two sub-histograms HL(**X**) and HU(**X**) by using the input mean *XM*,

where HL(**X**) is associated with the gray levels {*X*0, *X*1, …, *XM*} and HU(**X**) is associated with the gray levels {*XM*+1 , *XM*+2 ,..,

XL-1}[14].Then it performs conventional histogram equalization on HL(**X**) and HU(**X**) independently.

vi) Recursively Separated and Weighted Histogram Equalization:

It enhances image contrast and also preserves image brightness. This technique covers up the mean shift problem of histogram equalization and is an extension of BBHE. Although BBHE carries out the mean based histogram segmentation only once but RSWHE segments both mean and median based histogram equalization more than once recursively. RSWHE changes the input histogram before running the equalization procedure. This is the difference between the previous methods and RSWHE. It divides input histogram into two or more than two sub-histograms recursively upto a specified recursion value r and creates upto 2*r* sub-histograms. The resultant sub-histograms are then equalized individually[14]. The histogram segmentation module takes the input image **X**, computes the input histogram H(**X**) and the histogram weighting module modifies the sub-histograms by using a normalized power law function. Lastly, the histogram equalization module runs histogram equalization individually over each of the modified sub-histograms[14].

III. CONCLUSION

Different enhancement techniques for enhancing road scene images is described in the paper. Image enhancement of road images improves the interoperatability or perception in images of road. Diverse issues emerge when the captured foggy road scene images contains restricted light sources or shading movement issues because of dust storm conditions, sunlight, fog or extensive variety of climate conditions. Motion Detection is also among one of the issue areas. Future extension can be to enhance the Road scene images using various methods. The distinctive sorts of parameters are computed that is PSNR, MSE and AMBE and to analyze the results being obtained.

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