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A Fast Sand Dust Image Enhancement Algorithm and Number Plate Detection

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Abstract: ***The color variation and limited visibility of images taken in sand-dust conditions have a significant negative impact on computer vision systems. We suggest a quick and efficient approach to improve photographs taken in sand-dust weather in order to address the aforementioned issues. First, we make amends for the blue channel's loss value. The color of the image that has been damaged by sand dust is then corrected using white balance technology. In order to improve the image contrast and edge accuracy, guided image filtering is utilized, and an adaptive approach is used to determine the detail layer's magnification factor in order to improve the image detail information. We also added an additional feature of number plate detection of the sandy images.The aim of this task is to develop an automated system that can accurately and efficiently detect and recognize number plates from sandy images captured by a camera. This technology has various applications, such as traffic control, toll collection, parking management, and law enforcement. The experimental results demonstrate that the approach can successfully restore the fading characteristics of a large number of sand-dust-damaged photos. The proposed method may considerably improve the photos acquired during sand-dust weather conditions, and the results are better than those of existing methods, according to experimental results via qualitative and quantitative assessments.***

Keywords: Sand-dust-degraded image, blue channel compensation, color correction, guided image filtering, number plate detection, image localization, OCR.

I. INTRODUCTION

Low contrast, color variation, and blur are common characteristics of photos taken in sand dust conditions, all of which have a negative impact on the image's clarity. This phenomenon's primary cause is the way sand-dust particles scatter and absorb light. As a result, the processing power of monitoring systems, automated driving, and remote sensing systems has been directly decreased by the sand-dust-damaged photos

Researchers have developed some visibility restoration techniques,to enhance the processing capability of computer vision systems in sand-dust environments. This past work to enhance the clarity of sand-dust images can be separated into three types.

While current methods for sand-dust-degraded image improvement can correct color discrepancies, improve image contrast, and increase image clarity, some issues still exist. First, blue artifacts appear in the photos and lower the image quality when the sand-dust-damaged photographs are processed using the present color restoration technique. Second, the temporal complexity of the present techniques for sand-dust-degraded image augmentation is considerable.

When the sand-dust-damaged photographs are handled using the current color restoration technique, blue artifacts first appear in the photos and reduce the image quality. Second, the current methods for sand-dust-degraded image augmentation are somewhat temporally difficult. Therefore, in this work, we suggest a quick and efficient technique that can enhance the contrast and Chroma of the photos that have been damaged by sand and dust. The main steps of the suggested method are listed below. The blue channel can be recovered by making up for the lost value using the first proposed blue channel recovery algorithm. A proposed adaptive method is used to calculate the magnification coefficient for the detail layer in order to improve the image detail information, and guided image filtering is used to improve the picture contrast and edge accuracy.

The additional feature of Number plate detection, is a technology used to automatically detect and recognize license plates from image. With the increasing number of vehicles on the roads, automated number plate detection systems can help to improve safety, reduce traffic congestion, and enhance security.The main objective of number plate detection is to accurately and efficiently identify the license plate region from the background and recognize the characters on the plate. This task can be challenging due to various factors such as lighting conditions, plate orientation, and background clutter. However, recent advances in computer vision and machine learning have led to significant improvements in number plate detection and recognition.

The experimental outcomes determined through qualitative and quantitative evaluations demonstrate that this strategy can quickly and effectively improve photos taken in sand-dust weather conditions, outperforming existing approaches.

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II. RELATED WORKS

1) Paper 1: Sand-Dust Image Enhancement Using Successive Color Balance with Coincident Chromatic Histogram [1]

Author: Tae Hee Park,et al

Methodology

The proposed method consists of four steps as follows.

Step 1: Adaptive initial color correction.

Step 2: Green mean-preserving color normalization technique.

Step 3: Color pixel shifting based on maximum histogram overlapping.

Step 4: Image adjustment for obtaining a brighter image.

Advantages :

1. Enhance the brightness of the image
2. Enhance the edge accuracy

Disadvantages :

1. color casts
2. dimmed colors
3. look unnatural

2) Paper 2: Sand dust image visibility enhancement algorithm via fusion strategy[2]

Author: Yazhong Si ,et.alMethodology

Methodology

A novel enhancement algorithm based on fusion strategy is proposed in this paper. It includes two components in sequence: sand removal via the improved Gaussian model-based color correction algorithm and dust elimination using the residual-based convolutional neural network (CNN). It includes a color correction pre-processing algorithm and a learning-based dust elimination network. The skip connection in the network can improve the robustness and accelerate the convergence speed of the network.

Advantages

1. can suppress the noise
2. adaptively adjust the brightness
3. stretch the contrast of the images.

Disadvantages

1. More computing needed
2. Takes more time

3) Paper 3: Blue channel and fusion for sandstorm image enhancement[3]

Author: Yaqiao Cheng,Zhenhong Jia

Methodology

Blue channel fusion-The method builds on the blending of two images that are directly derived from the original degraded image. Second, we use multilayer decomposition technology to enhance image details and use a blue channel and white balancing technology to restore image contrast and chromaticity. Third, we associate weight maps to improve image edge contrast. Finally, the Laplacian pyramid fusion method is used to obtain the fusion results of the sandstorm-free color correction image.

Advantages

1. Restore the fade characteristics of sandstorm-degraded images and improve the clarity of the images

Disadvantages

1.Less edge accuracy

4) Paper 4:Visibility enhancement for images captured in dusty weather via tuned threshold fuzzy intensification operators [4]

Author: Zohair Al-Ameen

Methodology

Tuned threshold fuzzy intensification operators.An innovative technique that utilizes tuned fuzzy intensification operators is introduced to expeditiously process poor quality images captured in an inclement dusty weather.Intensive experiments were carried out to check the processing ability of the proposed technique, wherein the obtained results exhibited its competence in

filtering various degraded images
Advantages
1. Robustness
2. Efficiency
Disadvantages
1. Complexity
2. Computational cost

5) Paper 5: Method to Enhance Degraded Image in Dust Environment [5]
Author:Ting.Yan,Liejun Wang
Methodology
PAL fuzzy enhancement
Firstly,convert the degraded image into fuzzy domain to global PAL fuzzy enhancement; then band-limited histogram equalization is adopted for enhancing the local component in the spatial domain; finally POSHE algorithm is introduced to enhance the details
Advantages
1. Good visual effect of the image
Disadvantages
1. Time complexity is high

6) Paper 6: Guided image filtering[6]
Author: Jian Sun,Xiaoou Tang,Kaiming He.
Methodology
Guided image filtering
It can transfer the structures of the guidance image to the filtering output, enabling new filtering applications like dehazing and guided feathering. Moreover, the guided filter naturally has a fast and non approximate linear time algorithm, regardless of the kernel size and the intensity range. Currently, it is one of the fastest edge-preserving filters.
Advantages
1.Remove noisy images
Disadvantages
1. Inaccurate results show a strong color cast in the image.

7) Paper 7: Automatic Number Plate Recognition[7]
Author Muhammad Tahir Qadri,Muhamamd Asif
Methodology
Optical Character Recognition
Optical Character Recognition (OCR) is the process that converts an image of text into a machine-readable text format. For example, if you scan a form or a receipt, your computer saves the scan as an image file. You cannot use a text editor to edit, search, or count the words in the image file.The steps are
1.Image acquisition
2.Preprocessing
3.Text recognition
4.Pattern matching
5.Feature extraction
6.Postprocessing

Advantages
1.Easy to detect
Disadvantages
1.Error in decoding

8) Paper8:Structure-Revealing Low-Light Image Enhancement Via Robust Retinex Model[8]

Author: M. Li, J. Liu, W. Yang, X. Sun, and Z. Guo,

Methodology

Robust Retinex Model

Based on the robust Retinex model, it presents an optimization function that includes novel regularization terms for the illumination and reflectance. Specifically, we use ℓ 1 norm to constrain the piecewise smoothness of the illumination, adopt a fidelity term for gradients of the reflectance to reveal the structure details in low-light images, and make the first attempt to estimate a noise map out of the robust Retinex model. To effectively solve the optimization problem, we provide an augmented Lagrange multiplier based alternating direction minimization algorithm without logarithmic transformation.

Advantages

1.Increased visibility

2. enhancement for underwater or remote sensing and in hazy or dusty conditions. language.

Disadvantages

1. Loss of detail

2.Artifacts

3.looks unnatural

9) Paper 9 Multinational License Plate Recognition Using Generalized Character Sequence Detection [10]

Author : M. Li, J. Liu, W. Yang, X. Sun, and Z. Guo,

Methodology

YOLOv3

YOLOv3 (You Only Look Once, Version 3) is a real-time object detection algorithm that identifies specific objects in videos, live feeds, or images. The YOLO machine learning algorithm uses features learned by a deep convolutional neural network to detect an object

Advantages

1.Effectively classify among various LP layouts.

Disadvantages

1.Difficult for blurred images.

10) Paper 10: Robust automatic white balance algorithm using gray color points in images.[10]

Author : J.-Y. Huo, Y.-L. Chang, J. Wang, and X.-X. Wei

Methodology

White balance algorithm

Automatic white balance (AWB) algorithms try to correct for the ambient light with minimum input from the user, so that the resulting image looks like what our eyes would see.Automatic white balancing is done in two steps:

Step 1: Estimate the scene illuminant.

Step 2: Correct the color balance of the image.

Advantages

1. Enhance the quality of the image.

Disadvantages

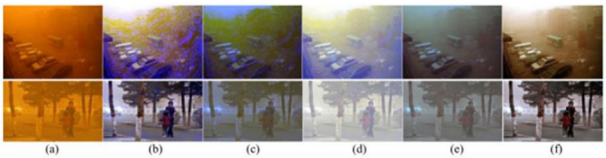
1. More computing needed

2. Takes more time

III. TECHNOLOGIES USED

A. Blue Channel Compensation

In sand-dust environment conditions, most of the blue light is scattered and absorbed, which causes the images captured in sand-dust weather to have an overall yellow appearance and color distortion. To correct the yellow appearance, we apply white balancing, gray world, the optical compensation method (OCM) [11] and color balance [6] processing to the sand-dust-degraded images. The results are shown in Fig. 3.2



We compensate the missing blue channel through the following three observations. First, most of the blue light in the sand-dust weather conditions is scattered and absorbed; therefore, an image captured in sand-dust weather appears yellow overall. Hence, if we want to better handle the sand-dust images, we need to restore the blue channel. Second, the gray world assumes that the average reflection of the natural scenery of the light is the same in general, and all channels have the same mean value in a zero-depth scene; therefore, we can use this hypothesis to restore the blue channel by compensating for the lost value. Third, in sand-dust degraded image processing, we assume that the mean values of the green channel and the red channel are unchanged to carry out blue channel recovery experiments

B. White Balancing

We use Robust-AWB to correct the color deviation of the sand-dust image. The algorithm used the gray color points in the extracted image to estimate the color temperature. The color temperature of the light source was estimated by the small color difference between the gray color point and the gray color point under different color temperatures

C. Guided Image Filtering

Guided Image Filtering is a computer vision technique used for image enhancement and filtering. It is a type of edge-preserving smoothing filter that can be used to remove noise from an image while preserving its edges and details.

The guided image filter is a non-linear filter that uses a guidance image to control the filtering process. The guidance image can be any image that is related to the input image, such as a low-resolution version of the same image, a smoothed version of the same image, or an image with similar features or colors. The filter operates by computing a weighted average of the input image pixels, with weights determined by the similarity between the pixel and its neighboring pixels in the guidance image. This weighted average helps to preserve edges and details, while smoothing out noise and other unwanted artifacts.

Guided image filtering has a wide range of applications, including image enhancement, image denoising, edge detection, and tone mapping. It is a computationally efficient method and can be implemented in real-time on modern hardware.MobileNetV2 is a popular choice for number plate detection due to its ability to run efficiently on mobile devices and embedded systems. One of the advantages of MobileNetV2 for number plate detection is its small size and low computational requirements. This makes it suitable for deployment on devices with limited resources, such as smartphones and cameras.

D. MobileNetV2

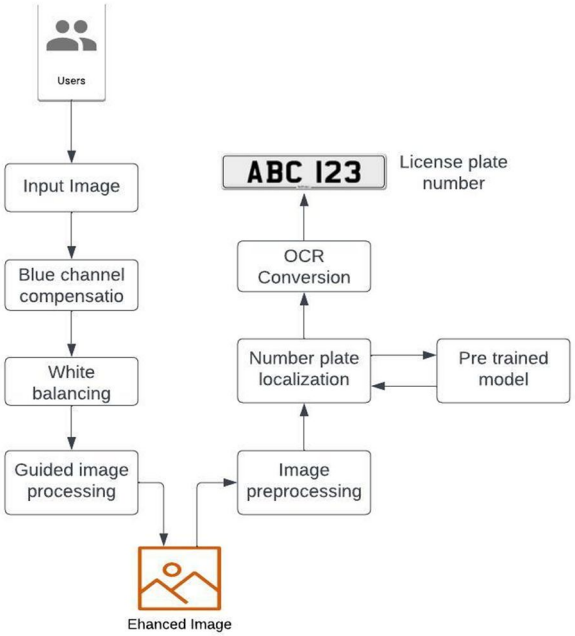
MobileNetV2 is a convolutional neural network (CNN) architecture that is designed for efficient and mobile-friendly image classification and object detection tasks. It is an extension of the original MobileNet architecture.MobileNetV2 can be used for number plate detection. During training, the MobileNetV2 architecture learns to identify features that are specific to number plates. Once the model is trained, it can be used to detect number plates in new images by running the model on the image and extracting the bounding boxes of the detected number plates. MobileNetV2's efficiency and accuracy make it a popular choice for number plate detection on mobile and embedded devices. By using this architecture, it is possible to detect number plates in real-time, which can be useful for applications such as traffic management, toll collection, and parking enforcement.

E. Haarcascade

Haar cascades are primarily used for detecting objects of interest, particularly faces, in computer vision applications. The approach involves training a classifier using a set of positive and negative training images. Positive training images contain examples of the object to be detected (e.g., faces), while negative training images do not contain the object.

Haar cascades can also be used for number plate detection in computer vision applications. The process involves training a Haar cascade classifier specifically for detecting number plates or license plates.Haar cascade is used when the MobileNetV2 is failed.After the training process is complete, you can use the trained Haar cascade classifier for number plate detection. The classifier is applied by sliding a window over the input image and evaluating each window using the classifier. If the response of the classifier exceeds a certain threshold, the window is considered to contain a number plate.

IV. ARCHITECTURE



There are various methods and techniques for enhancing sand dust images. Some of the most common methods include:

1) *Multi-scale Retinex:* Multi-scale Retinex is a method that uses the Retinex theory to enhance images. It works by decomposing the image into multiple scales and processing each scale separately to correct for differences in illumination and contrast.
2) *Adaptive Median Filter:* This method involves using a median filter to remove noise and artifacts from the image. However, unlike a traditional median filter, the size of the filter is adaptively adjusted based on the local noise characteristics of the image.
3) *Dark Channel Prior:* The Dark Channel Prior method is based on the observation that the dark channel of a haze-free image is likely to contain pixels with low values. The method works by estimating the haze in the image and then using this information to enhance the image.
4) *Wavelet Transform:* Wavelet Transform is a mathematical technique that decomposes an image into a series of sub-bands with different frequency ranges. This method is often used to enhance image details and remove noise.
5) *Local Contrast Enhancement:* This method involves enhancing the contrast in specific regions of the image based on the local image characteristics. This method can be used to enhance details in the image and improve overall clarity.
6) *Morphological Filters:* Morphological filters are used to remove unwanted structures or noise from the image. These filters can be used to remove small artifacts or speckles caused by dust particles

V. RESULT

a)Input Image 1

b) After blue channel compensation

c)after Guided image filtering

b)output Image 1

a)Input Image 2

b) After blue channel compensation

c)after Guided image filtering

b)output Image 2

a)Input Image 3

b) After blue channel compensation

c) after Guided image filtering

b) output Image 3

Number plate detection

VI. CONCLUSION

By creating this survey paper we were able to understand the relevant topic for the sand dust image enhancement by blue channel compensation and guided image filtering. Majority of the existing methods are not solving the issue of image enhancement, so we propose a system which is economically

feasible and easy to use. We propose a novel visibility restoration method based on blue channel compensation and guided image filtering that is used to recover sand-dust-degraded images. First, we used blue channel compensation technology to recover the lost value in the blue channel. Next, we used the white balancing technology to solve the color deviation problem and combined it with blue channel compensation technology to effectively resolve the appearance of blue artifacts. Finally, guided image filtering was used to enhance the image contrast and edge accuracy, and an adaptive method was used to calculate the magnification factor of the detail layer to enhance the image detail information. We also added an additional feature of number plate detection by mobileNetV2 and haar cascade.

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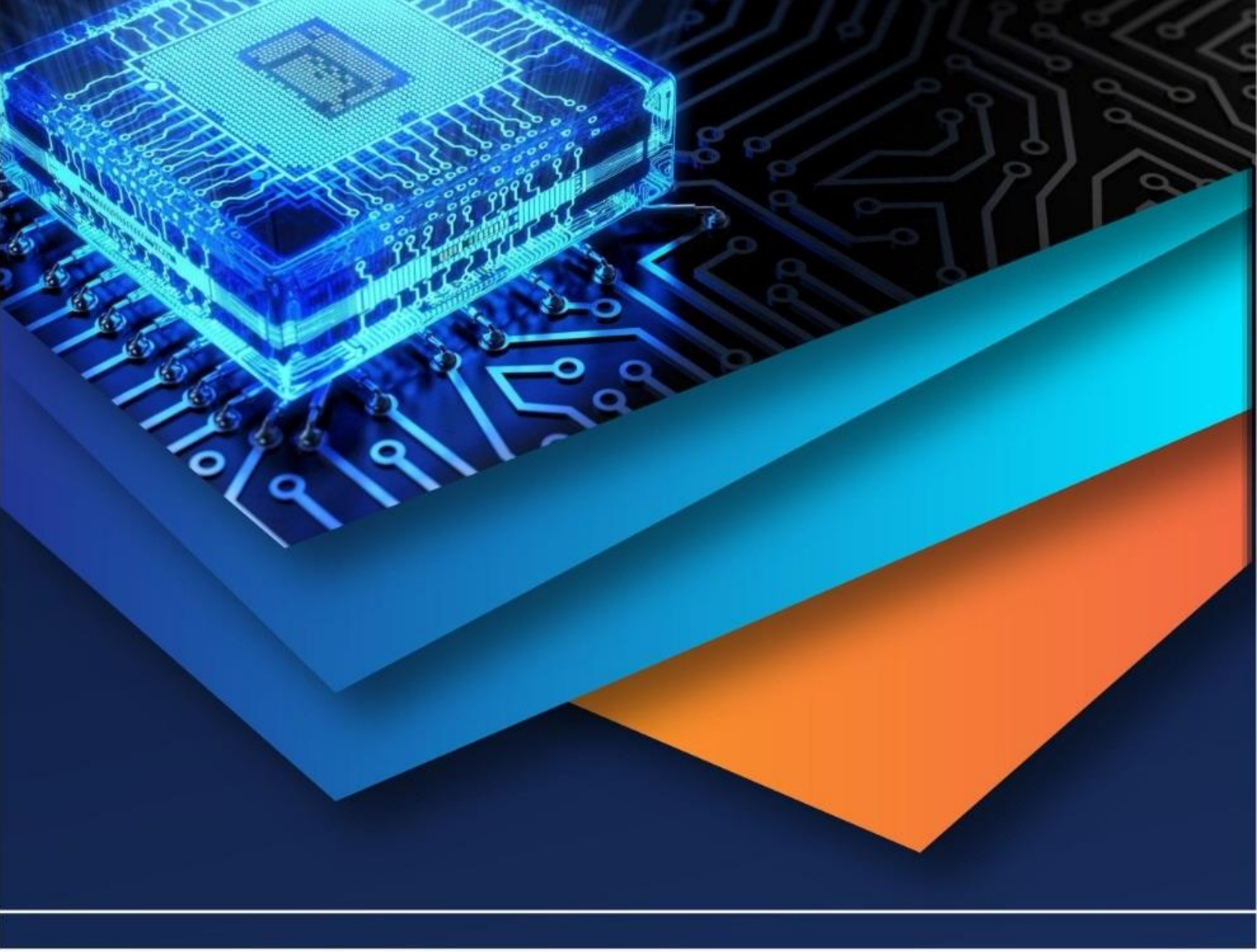

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