DOI: https://doi.org/10.17762/turcomat.v10i2.13580

Research Article

A Weakly Supervised Refinement Framework for Single Image De-Hazing

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Abstract
We suggest using a technology called De-haze-Net in this procedure to estimate medium transmission. De-haze-Net receives a hazy image as input and returns a medium transmission map that is then combined with an atmospheric scattering model to recover a haze-free image. De-haze-Net based deep architecture layers are specifically made to extract the characteristics of the hazy pixels, which are capable of producing practically all haze related features. Additionally, we suggest a nonlinear activation function for De-haze-Net termed a bilateral rectified linear unit, which can enhance the quality of the haze-free picture that is reconstructed. We develop links between the elements employed in conventional approaches and those proposed for the De-haze-Net.
Keywords: De-haze-Net, Hazy Image, Haze Free Images, Atmospheric Scattering Model, Nonlinear Activation Function.

1. Introduction

The most popular and practical method of sharing or distributing information is through images. There are a thousand words in a picture. Images clearly communicate information about the locations, dimensions, and connections between items. They depict geographical data that humans may identify as objects. Because of our natural visual and cerebral capacities, humans are adept at extracting information from such pictures. Humans get around 75% of their information in visual form. A picture is digitalized so that it may be saved in a computer's memory or on a storage medium like a CD-ROM or hard drive. After being digitised, an image can then be subjected to a variety of image processing techniques.

The three main categories of image processing activities are image compression, image enhancement and restoration, and measurement extraction. It includes lowering the memory need for digital image storage. Image enhancement methods can be used to fix image flaws that may have resulted from the digitization process or from errors in the imaging setup (for example, poor lighting). The Measurement Extraction techniques may be used to extract valuable information from the image after it is in good quality.

In this study, an empirical and automated approach for inhomogeneous haze identification also removal in medium- and high-resolution satellite optical multispectral pictures is presented. To estimate medium transmission in this procedure, we suggest using a method called De-haze-Net. By employing a concept for atmospheric scattering to recover a haze-free image, De-haze-Net takes a hazy image as input and produces a medium transmission map. De-haze-Net based deep architecture layers are specifically made to extract the features of the hazy pixels, which may yield practically all haze related characteristics. Additionally, we suggest the use of a nonlinear bilateral rectified linear unit activation function in De-haze-Net, which can enhance the quality of the haze-free picture that is reconstructed. We draw comparisons between the De-haze-suggested Net's elements and those being applied in practise.

Massive amounts of particles in our atmosphere make outdoor photography difficult. They make scenes look hazy or foggy, which lessens the visibility of things and their contrast and makes it more challenging to discern items within the image. However, modern advances in computer vision have made it feasible to enhance outdoor photographs and get rid of the haze layer. Images without haze are advantageous for several computer vision applications. These methods are based on scientifically valid notions from the fields of meteorology and other fields. Unfortunately, the intricacy of these approaches renders them unfit for real-time applications.

The dark channel prior, a powerful prior with a statistical foundation, serves as the foundation for this method. The degree of dehazing is measured using a novel method for assessment. Dehazing in real time is demonstrated by this thesis. Videos from airport ground surveillance are used to assess the validity and efficacy of the method. These findings open the way for new applications that need real-time picture dehazing, including high-definition, high-frame-rate outdoor surveillance, on-board vehicle camera systems, and many more.

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2. Literature Survey

The purpose of image processing is to use information from the image to help the system comprehend, interpret, and identify the processed data. Numerous branches of research and engineering can benefit from image improvement. This article discusses a number of methodological proposals for picture improvement. Along with a simple technique for contrast enhancement, analytical answers to several key requirements are offered. Histogram equalisation was examined in 2004 issue, and it was suggested that HE is a straightforward yet powerful picture enhancing approach. However, it has a propensity to expressively change the brightness of a picture, resulting in annoyance, artificial contrast augmentation, and artefacts. They put forth a brand-new improvement to BBHE called the minimal mean brightness error bi-histogram equaliser (MMBEBHE), which minimises the modest discrepancy between the input and output images. The results of the simulation demonstrated that MMB EBHE can retain brightness more effectively than BBHE and DSIHE. The best equalisation method is RMSHE, which is superior to HE, BBHE, DSIHE, and MMBEBHE. It adds a straightforward but crucial local mean brightness maintaining mechanism to the DHE method. For consumer electrical items to use less energy, brightness preservation is crucial. Compared to the other contrast enhancement techniques, their suggested solution has used less power [1].

The various picture enhancing methods have been the main emphasis of this article. One of the most crucial uses for vision has been identified to be picture enhancement since it may make images more visible. It makes subpar images more noticeable. Different methods have so far been suggested for raising the quality of digital photographs. Image enhancement can explicitly enhance and limit some data given in the input picture in order to increase picture quality. It is a type of vision system that minimises picture noise, eliminates artefacts, and maintains the educational elements. Its goal is to make specific visual properties available for research, analysis, and future application. This paper's main goal is to identify the limits of the current picture enhancing techniques [2].

The area of image augmentation has attracted the attention of numerous computer vision and machine vision researchers. A variety of methods, including Histogram Equalization, Spatial Averaging, Median Filter, Un-sharp Masking, and High Boost Filtering, among others, were designed to improve images. By combining two strategies, we suggested a novel hybrid methodology in this work. An artificial neural network and fuzzy logic (ANN). Results from experiments are collected and contrasted using various metrics including MSE (Mean Square Error) and SNR (Signal to Noise Ratio). A group of approaches known as "image enhancement procedures" aim to enhance a picture's aesthetic appeal or change it into a format that is more suitable for either human or computer analysis. With the use of a membership transformation function, grey level mapping is the foundation of fuzzy image processing. The goal is to create a picture with a higher contrast level than the original. At the output, some deterioration takes place. Therefore, the main drawback of the technique is that the resulting image must go through a procedure known as image enhancement [3].

One of the most important difficulties with high-quality images, such as those from digital cameras and the field of image research, is image enhancement. The basic goal of image enhancement is to reveal hidden details in a picture or to boost low contrast images' contrast. For low contrast grayscale photos, we offer a unique adaptive fuzzy contrast enhancement method in this study that is depending upon the fuzzy entropy principle and fuzzy set theory. Image enhancement is a key procedure used in picture processing to enhance the image's look and readability. Every sector where pictures need to be comprehended and evaluated may apply image enhancement, including machine vision, satellite image analysis, medical image analysis, etc. The primary purpose of the picture enhancement is to make the information included in an image easier for human viewers to understand or see. This is a good way to enhance how easily human viewers can understand or see the information included in the image. However, the computational time for improvement is long [4].

A resolution technique for improving digital grayscale photographs is presented in this research. The high frequency sub-bands acquired by DWT and SWT are interpolated to create the suggested enhancement approach. The suggested method divides a picture into several sub-bands using DWT, after that interpolates the high frequency sub-band images. Using the high frequency sub-bands produced by SWT on the input picture, the interpolated high frequency sub-band coefficients have been rectified. The same interpolation factor is used to interpolate the lower sub band produced by DWT decomposition. After that, IDWT was used to integrate all of these pictures to create a super-resolved image. With the aid of the fusion, we have added further augmentation

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to the photograph. The goal of picture resolution augmentation is to get around an image acquisition equipment constraint or an awkward acquisition situation. The high frequency sub-bands acquired by DWT and SWT are interpolated to create the suggested enhancement approach. Super improved resolution is being obtained through image processing. High quality satellite photos are crucial since they are used in many different sectors nowadays [5].

3. Proposed System

Haze decreases the quality of optical data along with the precision of data interpretation. The tough and significant aspect of optical multispectral data correction is haze identification and removal. Inhomogeneous haze identification and removal in medium- and high-resolution satellite optical multispectral pictures are addressed using an empirical and automated technique in this work. To construct a haze thickness map and remove haze from both calibrated and uncalibrated satellite multispectral data, the dark-object subtraction approach is further refined. The approach has limits in rare settings with a homogenous and strongly reflective ground cover. The spectral consistency after haze reduction is evaluated using hazy multispectral data (Landsat 8 OLI and WorldView-2) and contrasted with haze-free reference data.

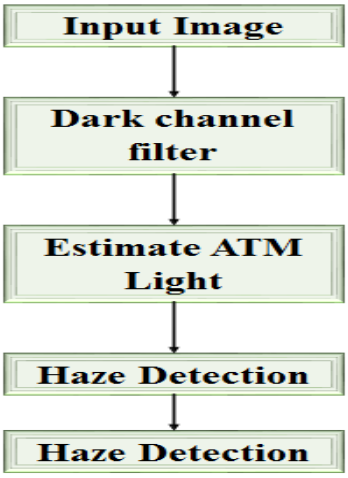

Fig 1: System Architecture

With the use of a dark channel prior and haze imaging model, we suggest a novel haze removal method for a single input hazy image. The hazy picture must first be modelled using,

$$\frac{I^c(\mathbf{x})}{A^c} = t(\mathbf{x})\frac{J^c(\mathbf{x})}{A^c} + 1 - t(\mathbf{x}).$$

Calculate the transmission using the following normalised haze equation:

$$\tilde{t}(\mathbf{x}) = 1 - \min_{\mathbf{y}\in\Omega(\mathbf{x})}\left(\min_c \frac{I^c(\mathbf{y})}{A^c}\right).$$

Using the following equation, the scene's radiance is then calculated:

$$\mathbf{J}(\mathbf{x}) = \frac{\mathbf{I}(\mathbf{x}) - \mathbf{A}}{\max(t(\mathbf{x}), t_0)} + \mathbf{A}.$$

1. Input Image

Every vision system begins with the picture acquisition phase. Picture acquisition is the process of digitising and archiving an image. To perform the numerous visual jobs required today, the image may be processed with a number of approaches after it has been taken. First Utilize the uigetfile and imread functions to extract the input image from the source file. The activities that were intended could not be accomplished even with the aid of any form of image enhancement if the image was not gathered properly.

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2. Preprocessing

The technique of reducing noise from a signal is known as noise reduction. Analog and digital recording equipment alike have characteristics that make noise intrusion a possibility. Random or incoherent white noise, as well as coherent noise brought on by a device's mechanism or processing algorithms, are all types of noise. Hiss is a common type of noise in electronic recording equipment brought on by haphazard electrons that deviate from their intended route under the strong impact of heat. These errant electrons alter the output signal's voltage and produce audible noise as a result. Due to the medium's grain structure, noise (both auditory and apparent) is added to magnetic tape and photographic film. The size of the film's grains impacts the sensitivity of photographic film, with larger grains indicating more sensitivity. The more ferric oxide or magnetite grains there are on a magnetic tape, the greater the grain size, the more noise-prone the medium is.

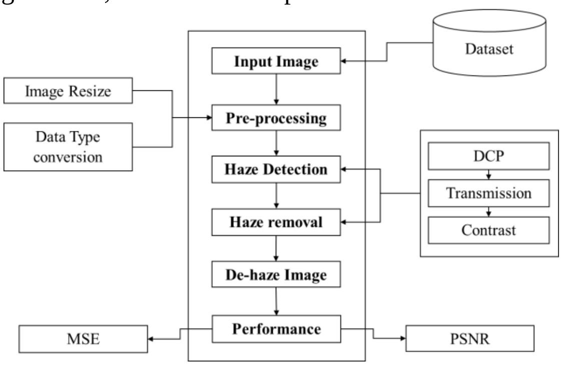

Fig 2: Flow Diagram

3. Haze Detection

Haze is often an atmospheric condition when dry particles like dust, smoke, and other materials obstruct the view of the sky. A categorization of horizontal obscuration into the following categories is included in the World Meteorological Organization's manual of codes: fog, ice fog, steam fog, mist, haze, smoke, volcanic ash, dust, sand, and snow. Agriculture (especially ploughing in dry weather), transportation, industry, and wildfires are all sources of haze particles. When viewed from a distance (such as an incoming aeroplane) and depending on the direction of the sun, haze may seem blue or brownish, whereas mist often appears bluish-grey. Mist production is a phenomena of humid air, as opposed to haze, which is commonly seen as an effect of dry air. The term "wet haze" refers to haze that contains particles that can serve as condensation nuclei for the subsequent creation of mist droplets.

4. Haze Removal

The former removes the veil layer using the illumination component picture produced by the Retinex algorithm and the depth data of the original image. In order to achieve the refined haze transmission and to separate it from the original image, the latter uses a guided filter. The key benefits of the suggested solutions are that they don't require any user participation and that the processing is done very quickly. Comparative research and quantitative comparison with some of the most important existing algorithms show that the suggested approaches can provide results that are comparable to or even superior in quality. Along with haze removal, a number of haze transmission applications are also used, including picture refocusing, haze simulation, relighting, and 2D to 3D stereoscopic conversion.

5. Estimations

A random variable's variance is equal to the square root of its standard deviation in a statistical population, data collection, or probability distribution. While it is algebraically simpler than the average absolute deviation, it is less dependable in actual use. Because the standard deviation is reported in the same units as the data, unlike the variance, this is a beneficial attribute. Other metrics of departure from the norm exist as well, such as mean absolute deviation, which has mathematical features distinct from standard deviation.

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4. Results

We suggest using a technology called De-haze-Net in this procedure to estimate medium transmission. De-haze-Net receives a hazy image as input and returns a medium transmission map that is then combined with an atmospheric scattering model to recover a haze-free image. De-haze-Net based deep architecture layers are specifically made to extract the characteristics of the hazy pixels, which are capable of producing practically all haze related features. Additionally, we suggest a nonlinear activation function for De-haze-Net termed a bilateral rectified linear unit, which can enhance the quality of the haze-free picture that is reconstructed. We draw comparisons between the elements utilised in conventional approaches and those proposed in the De-haze-Net. The following screenshots demonstrate how our De-Haze System has performed:

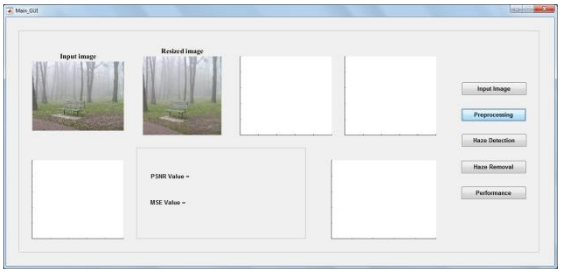

Fig 3: Pre-Processing

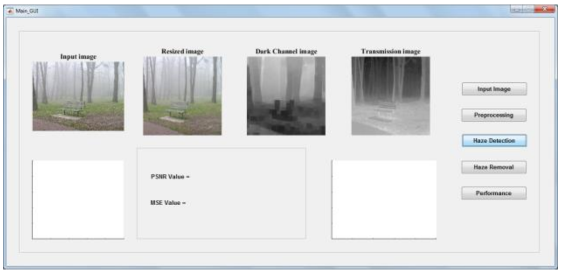

Fig 4: Haze Detection

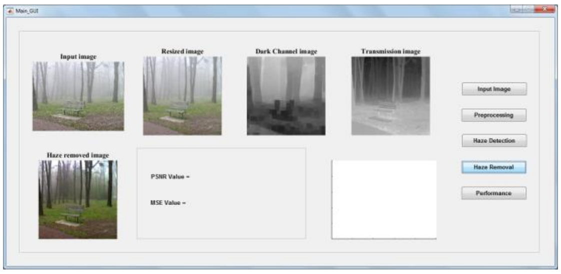

Fig 5: Haze Removal

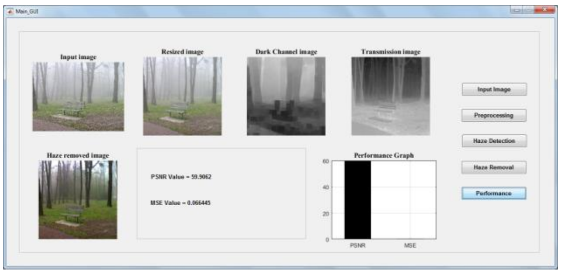

Fig 6: Performance Analysis

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5. Conclusion

In this study, we describe an unique Laplacian-based visibility restoration method enables damaged photos taken in bad weather, such sandstorms and fog, to be restored. The suggested approach uses a combination of the suggested HTE and IVR modules to effectively reduce haze creation and restore vivid scene colour in a picture. It is depending upon the Laplacian distribution model. The suggested IVR module uses the improved transmission map to improve the quality of a damaged image following the suggested HTE module uses laplacian-based gamma correction to refine an inadequate transmission map and obtain an accurate measurement of haze thickness.

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