Effective Single Image Dehazing by Fusion

03CS6902 Mini Project
Design Report

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Abstract

This project is an attempt to implement an effective fusion-based technique to enhance both day-time and night-time hazy scenes. The implementation is based on Dark Channel Prior along with a Fusion followed by a local airlight estimation.The outdoor images captured in inclement weather are degraded due to the presence of haze, fog, rain and so on. Images of scenes captured in bad weather have poor contrasts and colors. This may cause difficulty in detecting the objects in the captured hazy images. Due to haze there is a trouble to many computer vision applications as it diminishes the visibility of the scene.In image processing area haze removal 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. Therefore many researchers adopted the method in which they have considered multiple images or additional images. There exists some methods for dehazing and these are based on the partial estimation of atmospheric light. Above methods are not worked when the scene objects are inherently similar to the atmospheric light and no shadow is cast on them (such as the Snowy Ground).So in this project I am trying to find a new solution for image dehazing by fusion such that it may give better result from the previous one

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Chapter 1

Introduction

1.1 Single Image Dehazing by Fusion

Haze is a challenging problem that degrades the quality of digital images.Image dehazing can provide the best solution to enhance these images.In image processing area haze removal is one of the challenging problem or task as because the haze is dependent on unknown depth.

1.1.1 Problem Statement

For a single input hazy image the haze removal problem is under constrained problem.More recently, several techniques have introduced solutions that do not require any additional information than the single input hazy image. While the effectiveness of these techniques has been extensively demonstrated on daylight hazy scenes, they suffer from important limitations on night-time hazy scenes.Obviously, the problem of dehazing of night-time scenes is more challenging. This is mainly due to the multiple light sources that cause a strongly non-uniform illumination of the scene. As a result, the night-time dehazing problem has been addressed only by a limited number of researchers, who introduced methods specific to night-time conditions.

So we need to require a technique that will produce a good result for both day and night hazy scenes.

1.1.2 Proposed Solution

Introduce an effective fusion-based technique to enhance the visibility of hazy scenes both in day or night conditions.Using local airlight estimation method on different patch sizes of single hazy input image, derive the first two inputs of the fusion approach and the third input is defined to be the Laplacian of the original image.The important features of these derived inputs are filtered based on several quality weight maps (local contrast, saturation and saliency). Finally the derived inputs and the normalized weight maps are blended in a multi-scale fashion, using a Laplacian pyramid decomposition of the inputs and a Gaussian pyramid of the normalized weights.

Chapter 2

Project Design

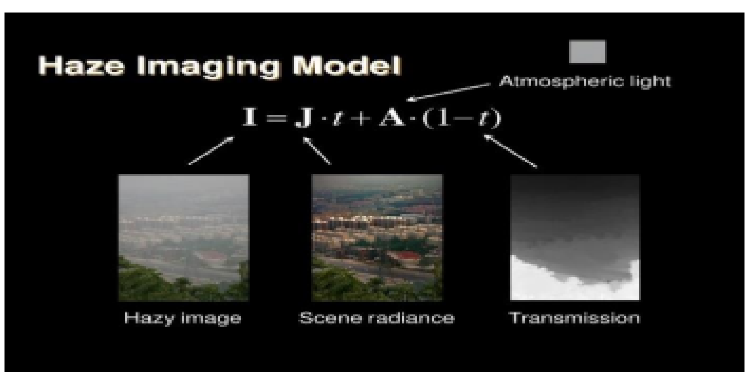
Images of outdoor scenes are usually degraded by the atmospheric particles like snow, water droplets, etc. So there is a resultant Detroiter in the color and Contrast of the captured image in the bad weather conditions.Haze is an atmospheric phenomenon that obscures the clarity of the sky.Haze is caused by atmospheric particles suspended in the air. It occurs in many populated areas like industrial areas. Due to haze clarity of images will be degraded. Haze is a combination of two components Airlight and Direct attenuation.

2.1 Observation model

Assume that this haze model is linear model. From the definition of linearity in this model only pixel position is changed. Fog is the combination of Airlight and Direct attenuation. This invisibility is occurred by two fundamental phenomenon's: Direct attenuation and Airlight.The equation below is usually used to describe the formation of a foggy or hazy image or

$$I(x) = D(x) + A(x)$$

$$I(x) = J(x)T(X) + A_{\infty}(1 - T(x))$$



where J(x) is the scene radiance or haze-free pixel color, T(x) is the transmitivity along the cone of vision, and A is the atmospheric intensity, resulting from the environmental illumination.

2.2 Algorithm

2.2.1 Main algorithm

step 0 : Input a hazy scenes (I)

Step 1 : Deriving Inputs for Fusion
- step 1.1 : Apply DCP on selected small patch size of I (I1)
- step 1.2 :Apply DCP on selected large patch size of I (I2)
- step 1.3 : Apply Laplacian filter on I (I3)

step 2 : Filter I1,I2 and I3 using weight maps.

step 3 : Multi-Scale fusion ,using a Laplacian pyramid decomposition of the inputs and a Gaussian pyramid of the normalized weights.

2.2.2 DARK CHANNEL PRIOR(DCP) Algorithm

step 1 : Find the dark channel

$$\min_{y\in\Omega(x)} (\min_{c\in r,g,b} (J^c/A^c_\infty) = 0$$

step 2 : find transmission T(x) ;

$$T(x) = 1 - \min_{y\in\Omega(x)} (\min_{c\in r,g,b} (J^c/A^c_\infty)$$

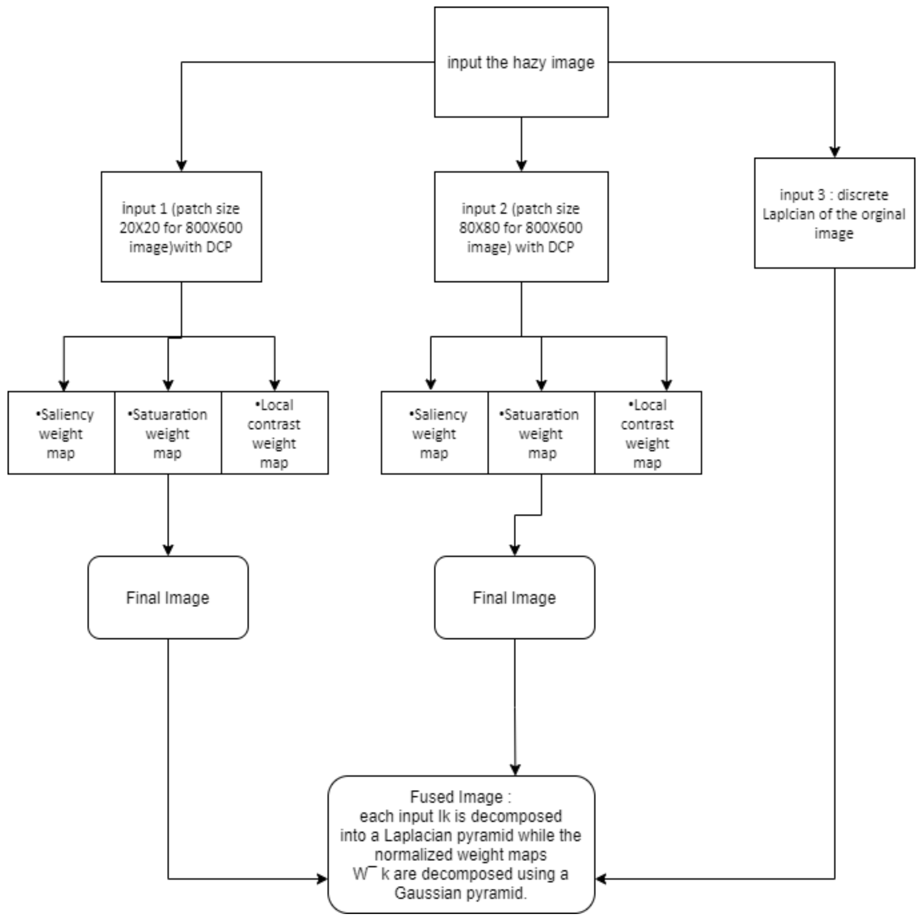
step 3 : Atmospheric Intensity Estimation using :

$$A^c_{L\infty}(x) = \max_{y\in\Psi}(I^c_{MIN}(y))$$

step 4 : find haze free image :

$$J(x) = ((I(x) - A)/T(x)) + A$$

2.3 Work Flowchart



2.4 Hardware & Software Requirements

Operating System : Windows 10
Supporting software : Python,Numpy,Opencv
Processor : Intel Core i5 10th GEN
RAM : 8GB

Chapter 3

Project Progress

3.1 Work done so far

1.Studied over the project area and problem domain.
2.Literature survey over the topic Single image Dehazing techniques and selected suitable reference papers.
3.Making a proper work schedule for implementing the work.
4.Started work on first phase of project- create design for project along with initial work on DCP algorithm.

3.2 Work Schedule

1.Implementation of DCP algorithm and local airlight estimation
2.Study on image fusion.
3.Implementing multi-scale fusion using a Laplacian pyramid decomposition.
4.Testing over the implementations
5.Complete the entire coding and testing
6.Check performance and do analyze over other techniques.
7.Prepare for the final presentation

References

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