Efface the haze

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1. Problem Statement

Haze, fog or smoke will greatly reduce the quality of outdoor scenery images, and the irradiance received by the camera from the scene point will be attenuated along the line of sight. These degraded images tend to lose contrast and color fidelity, because the amount of scattering will depend on the distance between the scene point and the camera, and the degradation will have spatial variant. To handle the dehazing, many techniques are developed and it plays an important role in improving the performance of computer vision applications.

The main aim of this project is to apply CV techniques and develop pipeline for image enhancement via Dehazing.

2. Motivation

- Dehazing causes the captured image to be blurred, which makes the process of inferring depth map difficult. Such images are not useful and visually pleasing. This can also result in road accidents in cities with high pollution levels such as Delhi and Beijing.
- For national defense vehicles, especially for countries like India, surveillance must be carried out in a hazy area, which makes the process of autonomous surveillance difficult due to poor vision.
- Implementation of self-driving cars in all weather conditions needs clear visual signal for accurate depth perception.

3. Literature Review

- Most of the existing image dehazing methods can be divided into two classes - traditional prior-based methods and modern learning-based methods, which are used to solve the unknown transmission map and atmospheric light problems.
- Later, a proposal for a dark channel was proposed to estimate the transmission map but it is found to be unreliable when the scene objects are similar to the atmospheric light.
- With the help of deep learning, an end-to-end dehazing model based on convolution neural network DehazeNet, takes a hazy image as input and outputs its medium transmission map, which is later used to recover a haze-free image via the atmospheric scattering model.

4. Project Tasks, datasets and Evaluation Matrics

1. Apply traditional CV techniques to perform dehazing. The techniques include Wavelet based, Image Pyramids, histogram based and custom filter based techniques
2. Develop pipeline by combining traditional CV techniques for image dehazing . These are the baselines (result1)
3. Develop/Apply image reflection removal optimisation techniques to perform image dehazing (result2)
4. Implement and reproduce existing results of the paper AAAI 2020 paper - FFA-Net: Feature Fusion Attention Network for Single Image Dehazing
5. Design own architecture to obtain possible improvements of the current/near to SOTA (Probable improvements : Cross residual connections in UNET, Channel Fusion across residual connections with attention, Learned Group Pixel attention, Design custom loss function instead of just L1 (can be a variant of perpetual loss) etc...)
6. Analyse suitability of current metrics PSNR & SSIM and design more relevant metrics for performance (Tentative)
7. Apply improved pipeline to video data for dehazing

Evaluation Metrics:-

- Peak Signal to Noise Ratio : Used to measure the peak signal to noise error .

$$PSNR = 20 \log_{10} \left(\frac{MAX_f}{\sqrt{MSE}} \right)$$

- Structural Similarity Index Error : To measure the similarity of two images .

$$\mathrm{SSIM}(x, y) = \frac{(2\mu_x\mu_y + c_1)(2\sigma_{xy} + c_2)}{(\mu_x^2 + \mu_y^2 + c_1)(\sigma_x^2 + \sigma_y^2 + c_2)}$$

HSTS. Top row: 10 synthetic hazy images; Bottom row: 10 realistic hazy images.

Reside- Standard Dataset: - Reside dataset has 13,990 images in indoor training set, 500 images in Synthetic Objective Training set and 20 images in Hybrid Subjective Training set. Also we will consider other datasets such as Data from NTIRE 2021 NonHomogeneous Dehazing Challenge for additional training along with testing.

5. Timelines

Week 1 - Implementing the pipeline for image enhancement via Dehazing.
Week 2 - Implementing image reflection removal optimisation techniques to perform image dehazing.
Week 3 - Implementing and reproducing existing results of the paper AAAI 2020 paper - FFA-Net: Feature Fusion Attention Network for Single Image Dehazing
Week 4 - Implementing own architecture to obtain possible improvements of the current/near to SOTA
Week 5 - Analyzing results

6. References

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