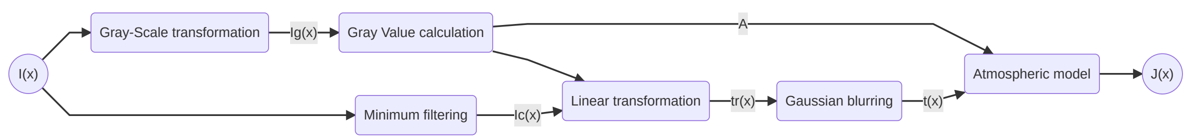
Documentation for Dehazing

Project is an implementation of this paper http://dx.doi.org/10.1109/TMM.2017.2652069

The paper tries to work it's way backwards from a hazy to a non hazy image using this equation: $I(x) = J(x)t(x) + A(1 - t(x))$

- $I(x)$ is the hazy image
- $J(x)$ is the non hazy image
- A is the atmospheric light
- $t(x)$ is the medium transmission map

Steps involved



- **Gray-Scale transformation**: Conversion of RGB hazy image to grayscale.
- **Gray Value calculation:** Calculating mean of the top x% brightest pixels of the hazy image. Gives A
- **Minimum filtering**: Finding the color channel with minimum intensity in all the pixels. Gives $\min I_c(x)$
- **Linear Transformation**: Using A and hazy image to calculate $t_r(x)$ using the formula $t_r(x) = \frac{A - \min I_c(x)}{A - \delta \times \frac{\min I_c(x) - \min(\min I_c(x))}{\max(\min I_c(x)) - \min(\min I_c(x))} \times \min I_c(x)}$ where δ is the control factor.
- **Gaussian blurring**: $t(x) = t_r(x)^* G$ where G is the Gaussian window.
- **Atmospheric Model**: Finally retrieving the dehazed image using the formula $J(x) = \frac{I(x) - A}{max(t(x), t_0)} + A$

  where t_0 is the lower bound on the value of $t(x)$

Code

The paper is implemented in `dehazing.py`. Specific scripts for dehazing images and video are made separately: `dehazing_images.py` and `dehazing_video.py`

- `dehazing.py`

  Contains the `Dehazing` module containing all the required functions:

  - `__init__(self, delta, sigma, brightness_gain, kernel)`
    - delta is the control factor
    - sigma is the variance for the gaussian distribution
    - brightness_gain is for increasing brightness as a post processing step
    - kernel is the window for gaussian filter
  - `self.psnr(img1, img2)` takes two ndarrays of two images as input and outputs the Peak Signal-to-Noise Ratio

- `self.ssim(img1, img2)` takes two ndarrays of two images as input and outputs the Structural Similarity between them
- `self.atmospheric_light(img, x)` calculates atmospheric light using the hazy image and x. This is the "Gray value calculation" step
- `self.transmission_map(A, minIc)` calculates transmission map using the atmospheric light (A) and minimum color channel (minIc). This includes the "Linear Transformation" and "Gaussian blurring" step
- `self.recover_image(img, A, t)` recovering the dehazed image using the atmospheric light(A) and transmission map (t). This is the "Atmospheric Model" step
- `self.dehaze(img)` puts the previous three functions together

Example

```
import cv2
from dehazing import Dehazing

dehazer = Dehazing(delta=0.4, sigma=100, brightness_gain=1.15, kernel=(101, 101))
img = cv2.imread("hazy_image.png")
dh_img = dehazer.dehaze(img)

cv2.imshow("hazy", img)
cv2.imshow("dehazed", dh_img)
cv2.waitKey(0)
```