Illuminiation Correction Techniques

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Motivation of Project

- Removal of uneven and non-uniform illumination caused by several factors.
- Illumination correction is based on background subtraction.
- scene is composed of an homogeneous background and relatively small objects brighter or darker than the background.
- visual quality can further be improved by using image enhancement techniques

Noises in Image

- Image noise is random variation of brightness or color information.
- Types Of Noises

1- Gaussian Noise

2- Shot Noise

3-Anisotopic Noise

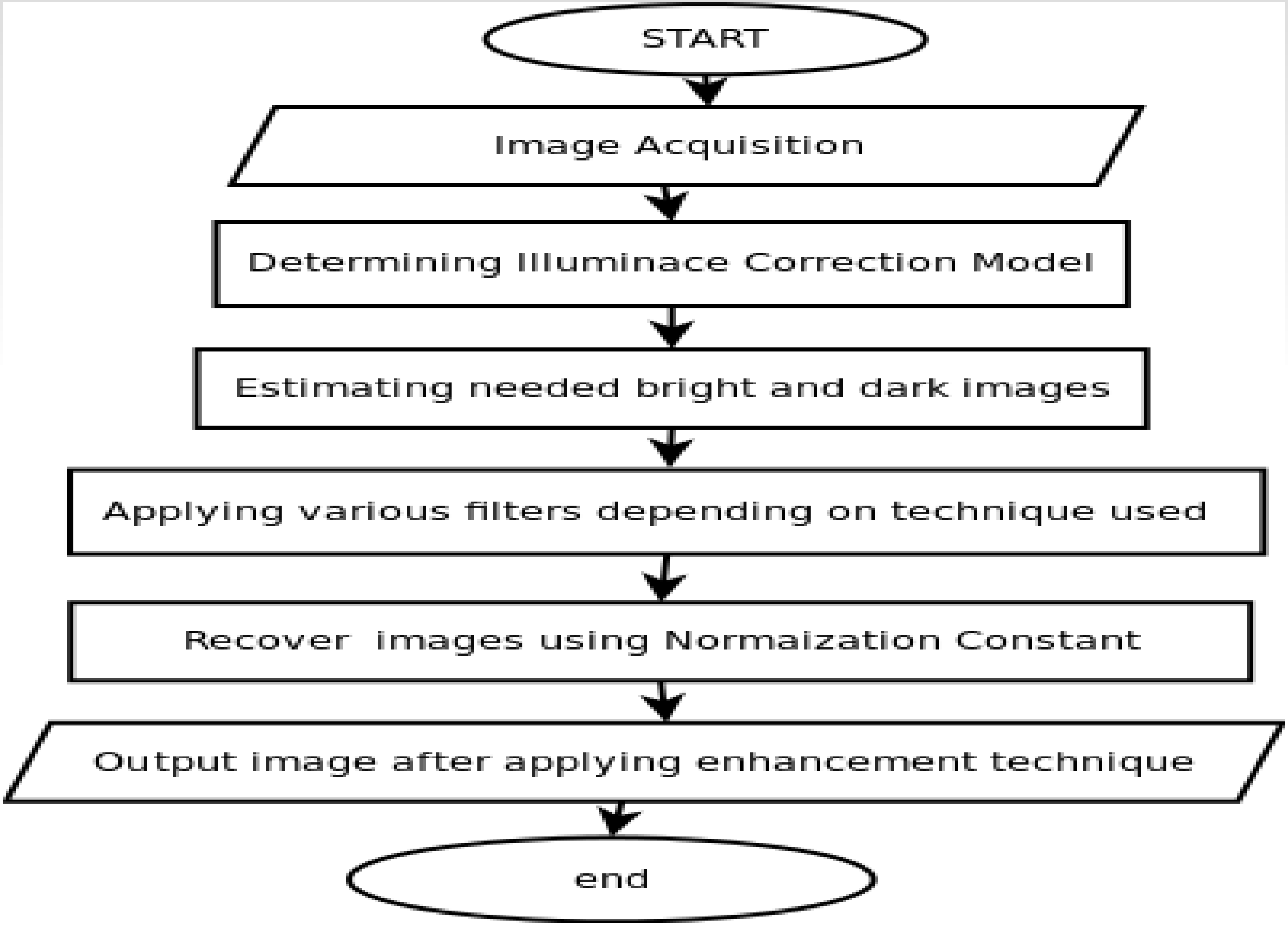
4- Quantization Noise (Uniform Noise)

Illumination Correction Techniques

- Prospective correction - uses additional images obtained at the time of image capture

- retrospective correction -When additional image are not available, model has to estimate the bright image

Project Flow



Prospective Correction

- Correction from a Dark Image and a Bright Image
- Correction from a Bright Image.
- Correction from a Dark Image

- **Correction from a Dark and a Bright Image**

- The corrected image g(x,y) is obtained using the following transformation:

$$g(x,y) = \frac{f(x,y) - d(x,y)}{b(x,y) - d(x,y)} . C$$

- where f(x,y) is the original image, d(x,y) is the dark image, b(x,y) is the bright image, and C is a

$$C = mean(f(x,y)) . \frac{1}{mean\left(\frac{f(x,y) - d(x,y)}{b(x,y) - d(x,y)}\right)}$$

normalization constant used to recover the original colors.

- where mean(i(x,y)) is the mean value of the image i(x,y).

Correction from a Bright Image

- In case of a linear acquisition device, the corrected image g(x,y) is obtained using the following transformation:

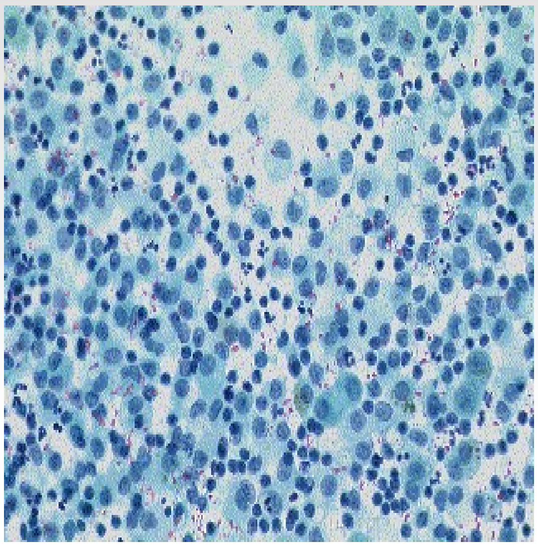
$$g(x,y) = \frac{f(x,y)}{b(x,y)} \cdot C$$

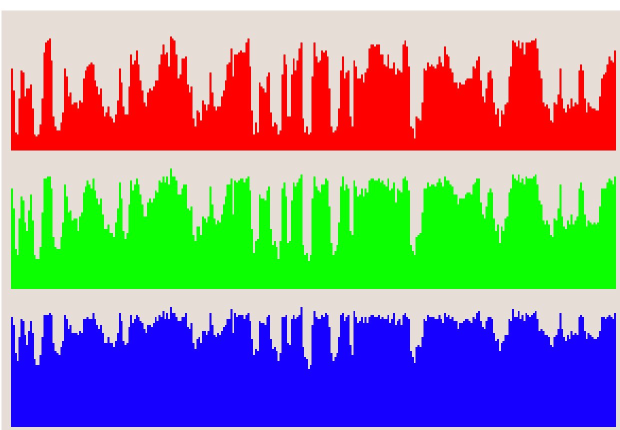
- where f(x,y) is the original image, b(x,y) is the bright image, and C is a normalization constant that is used to recover the initial colors:

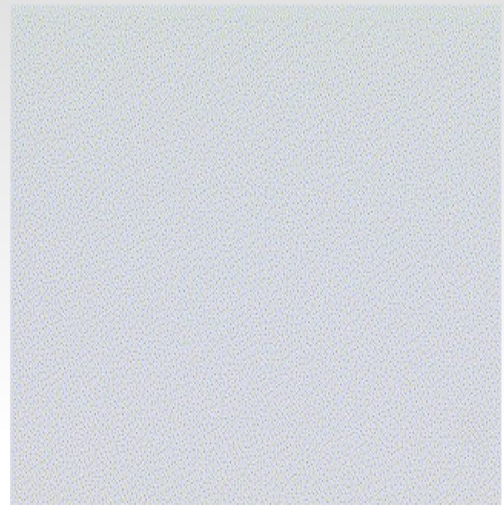
$$C = \text{mean}(f(x,y)) \cdot \frac{1}{\text{mean}\left(\frac{f(x,y)}{b(x,y)}\right)}$$

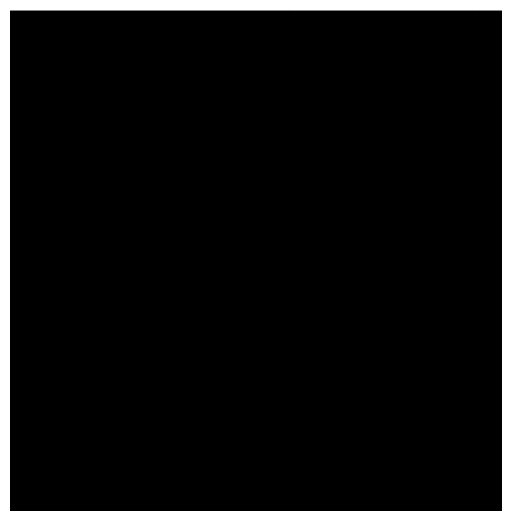
where mean(i(x,y)) is the mean value of the image i(x,y).

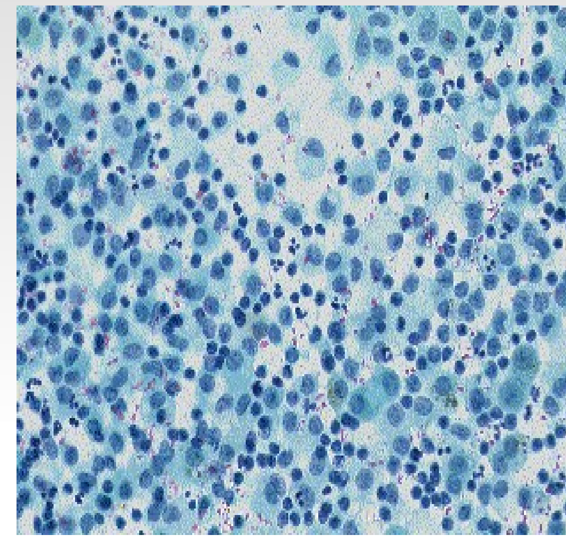
- **Correction from a Dark and a Bright Image**

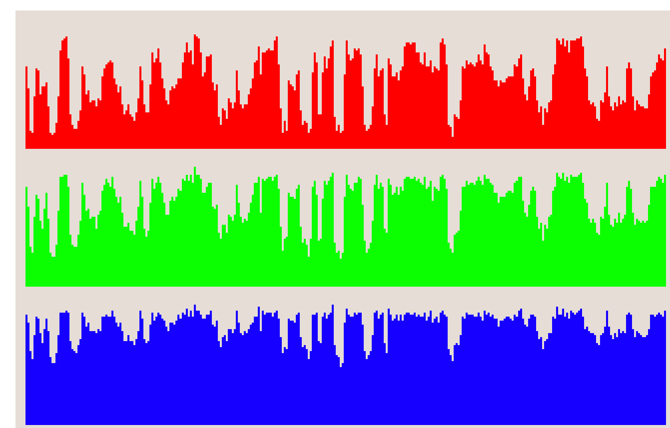












Correction from a Dark Image

- If only the dark image is available, the method consists in subtraction of the dark image with the original image.
- The corrected image $g(x,y)$ is then obtained using the following transformation:
- $g(x,y) = f(x,y) - d(x,y) + mean(d(x,y))$
- where $f(x,y)$ is the original image, $d(x,y)$ is the dark image and $mean(d(x,y))$ is the mean value of the dark image.

Retrospective Correction

- using Low-pass Filtering
- using Homomorphic Filtering
- using Morphological Filtering

Retrospective Correction using Low-pass Filtering

- Estimate background image by using a low-pass filtering with a very large kernel and subtract from input image to compensate the illumination.
- The corrected image g(x,y) is obtained from the input image f(x,y) by:
- $g(x,y) = f(x,y) - LPF(f(x,y)) + mean(LPF(f(x,y)))$

where LPF(f(x,y)) is the low-pass filtering of image f(x,y), and mean(LPF(f(x,y))) is the mean value of the low pass image.

Retrospective Correction using Homomorphic Filtering

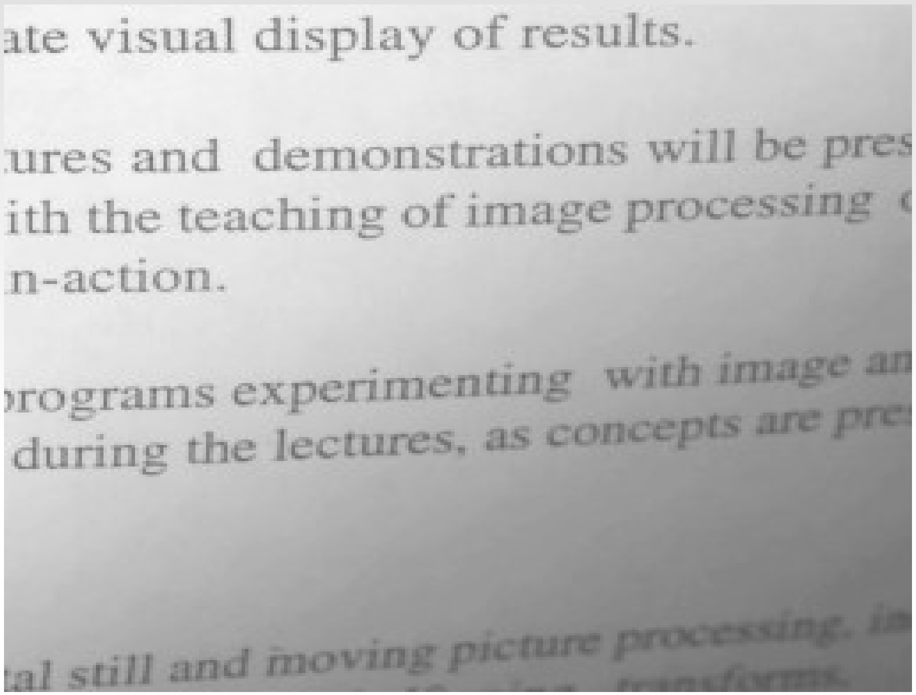
- The background is removed by highpass filtering the logarithm of the image and then taking the exponent (inverse logarithm) to restore the image.
- The corrected image g(x,y) is obtained from the input image f(x,y) by:
- g(x,y) = exp(LPF(log(f(x,y)))) . C

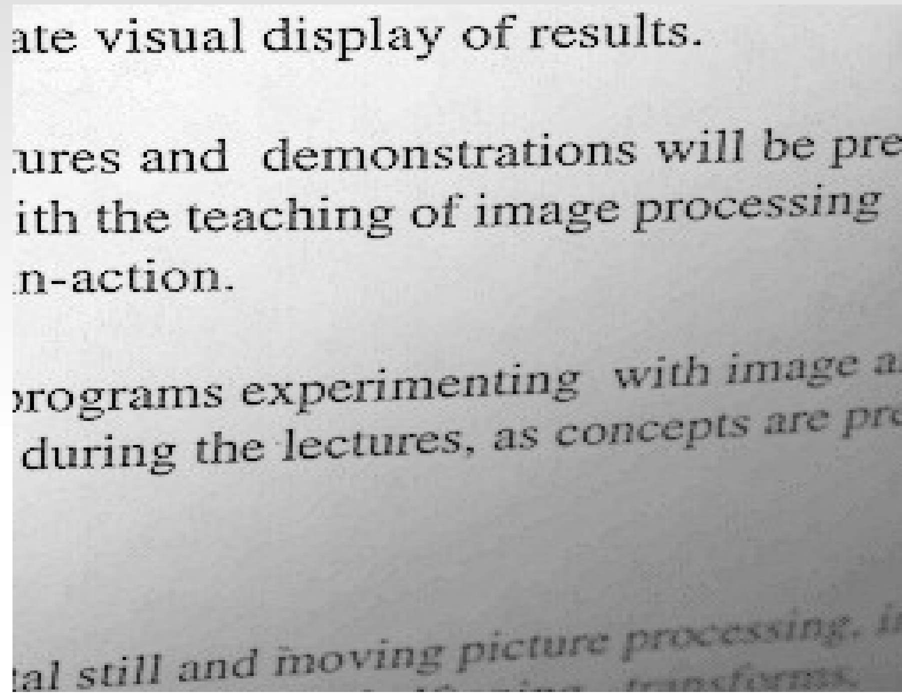
$$C = \frac{\mathrm{mean}(f(x,y))}{\mathrm{mean}\left(\dfrac{f(x,y)}{\exp(LPF(\log(f(x,y))))}\right)}$$

Retrospective Correction using Morphological Filtering

- Estimate background by mathematical morphology opening or closing.
- The total sequence of operations corresponds to a top hat of the image.
- If the background is clear, the corrected image g(x,y) is obtained using:
- g(x,y) = BTH[f(x,y)] + mean(closing(f(x,y)))
- g(x,y) = [f(x,y) - closing(f(x,y))] + mean(closing(f(x,y)))

Image after correction





Comparision Of various Methods

TABLE I. PSNR COMPARISON

No	Value PSNR		
	PSNR	*min*	*max*
1	Correction from a Bright Image and Dark Image	48	50
2	*Correction from Bright Image*	13	20
3	*Correction from Dark Image*	60	63
4	*Retrospective Correction using Low-pass Filtering*	20	25
5	Retrospective Correction using Homomorphic Filtering	16	20
6	Retrospective Correction using Morphological Filtering	3	10

Future Work

- Visual quality of images can further be improved by using image enhancement techniques.
- Above method can be used for increasing efficiency of character recognition from textual images.
- Above techniques can also be used in retinal and

  MRI scan images to remove illumination.

THANK YOU