CONTRAST ENHANCEMENT OF NIGHT IMAGES

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ISLab

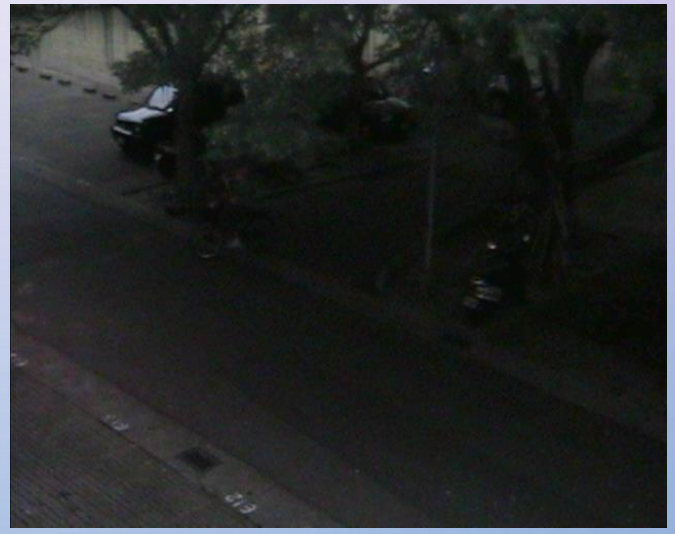
OUTLINE

1. Introduction
2. Night image enhancement algorithm
3. Results and discussion
4. Conclusion

1. INTRODUCTION

- Night images obtained from a surveillance camera have low visibility compared to daytime images.
- Low brightness, low contrast and high noise.

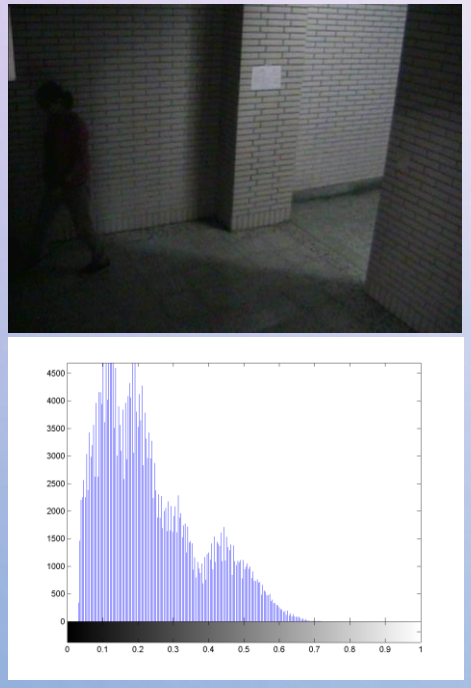
Day Image



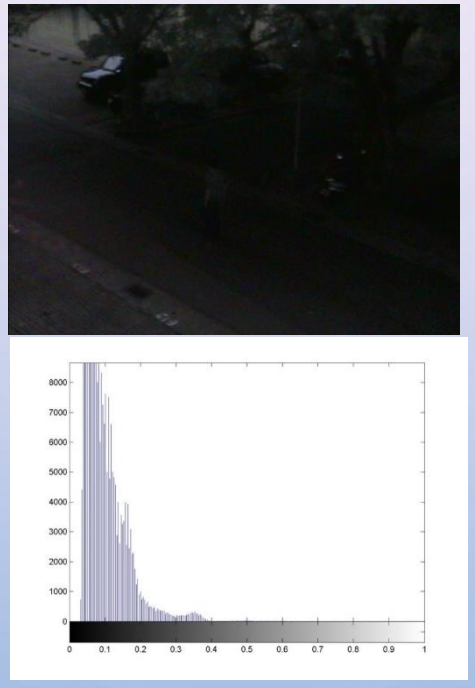
Night Image

TYPES OF CONTRAST

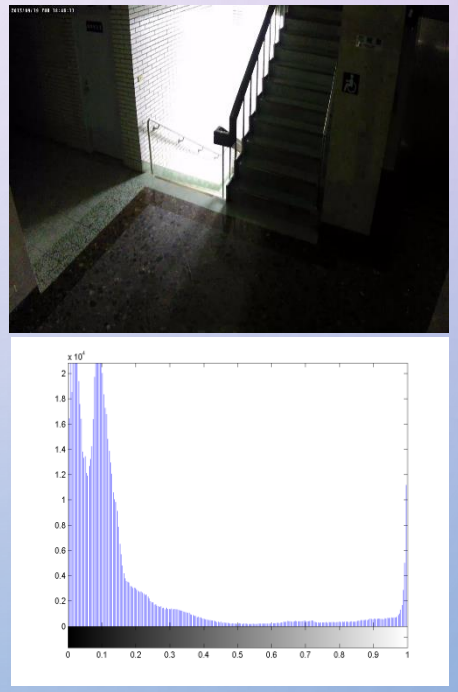
- LLL **:** Low Light Level image
- VLLL: Very Low Light Level image
- HDR: High Dynamic Range image



LLL



VLLL



HDR

Recent works – contrast enhancement (1/2)

Source

LLL

VLLL

HDR

Result

LLL

VLLL

HDR

- "A CUDA enabled parallel algorithm for accelerating retinex", Journal of Real-Time Image Processing, 2014.

Recent works – contrast enhancement (2/2)

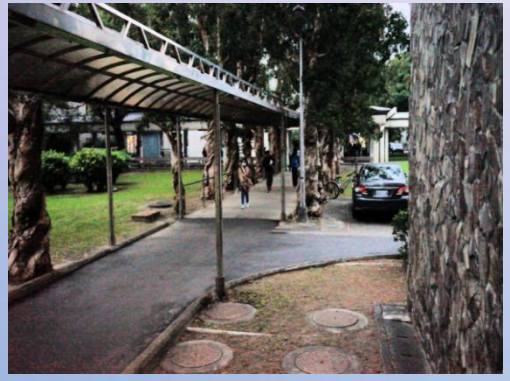
Source

LLL

VLLL

HDR

Result



LLL

VLLL

HDR

- "Content-aware dark image enhancement through channel division" , IEEE Trans. on Image Processing, vol. 21, no. 9, 2012.

Recent works – denoising (1/2)

Dark image – gaussian and uniform

Gaussian Noise

- " Content-aware dark image enhancement through channel division", IEEE Trans. on Image Processing, 2012.
- "Image denoising by sparse 3-D transform domain collaborative filtering", IEEE Trans. on Image Processing, 2007.

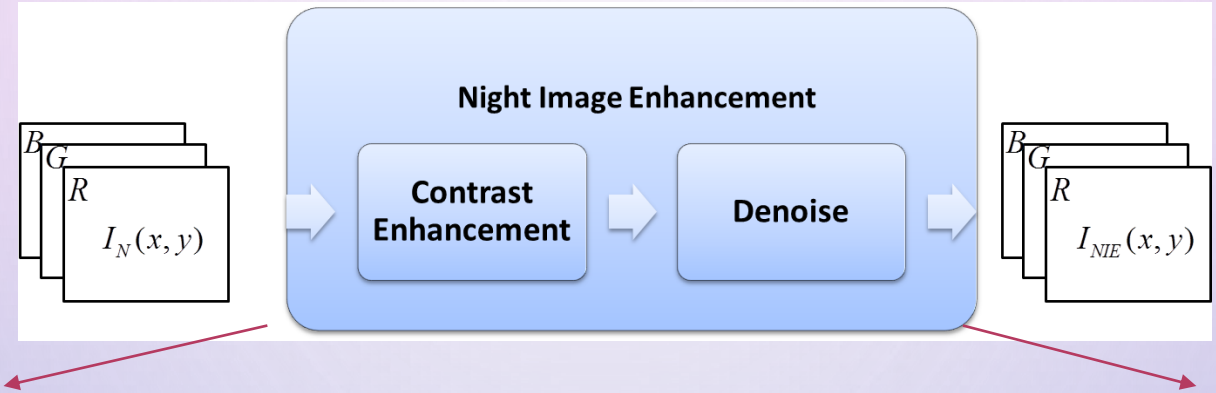
Recent works - denoising

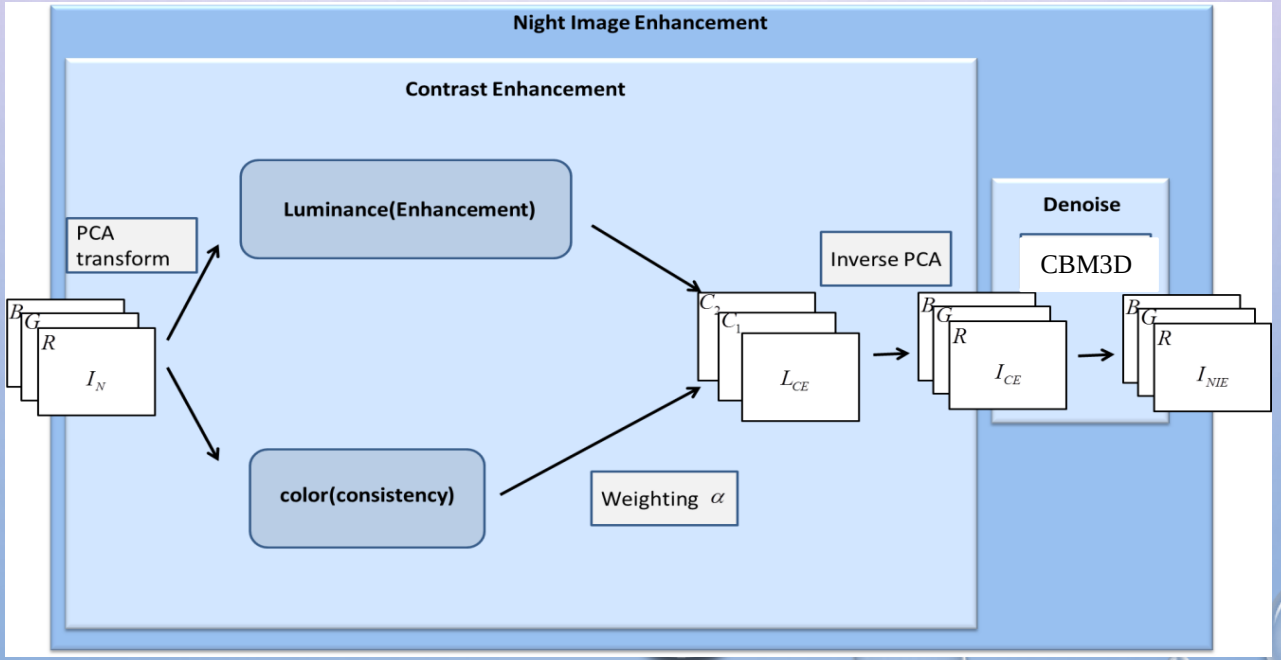
- **Night image – Poisson and false color noise**

- " A low-light image enhancement method for both denoising and contrast enlarging" , IEEE Int. Conf. on Image Processing (ICIP), 2015.
- "Robust contrast enhancement of noisy low-light images", IEEE Int. Conf. on Image Processing, 2015.
- "Noise-adaptive spatio-temporal filter for real-time noise removal in low light level images", IEEE transactions on Consumer Electronics, 2005.

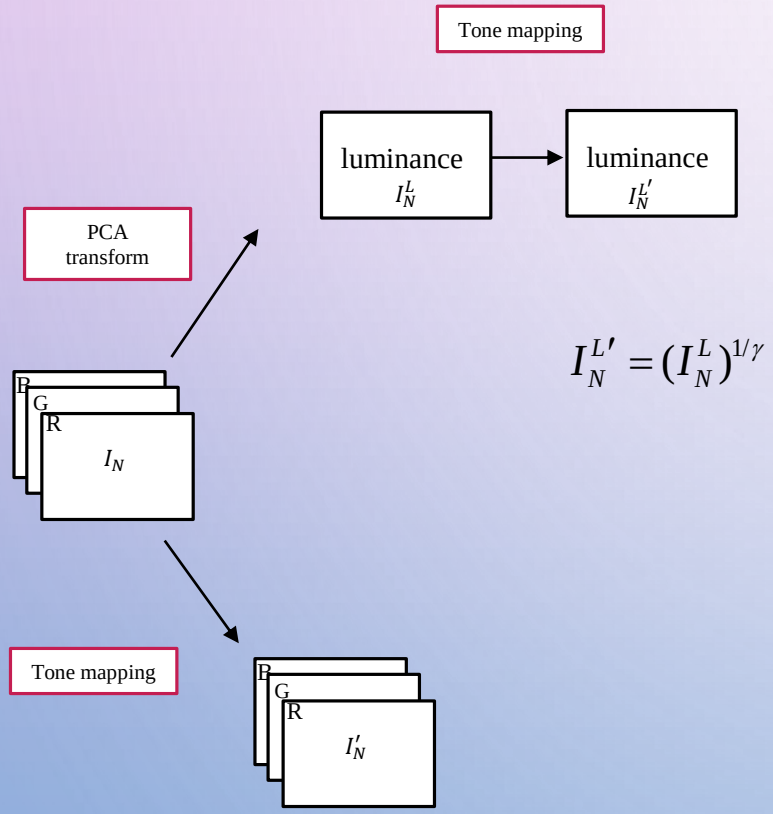
2. NIGHT IMAGE ENHANCEMENT ALGORITHM

- **ALGORITHM**



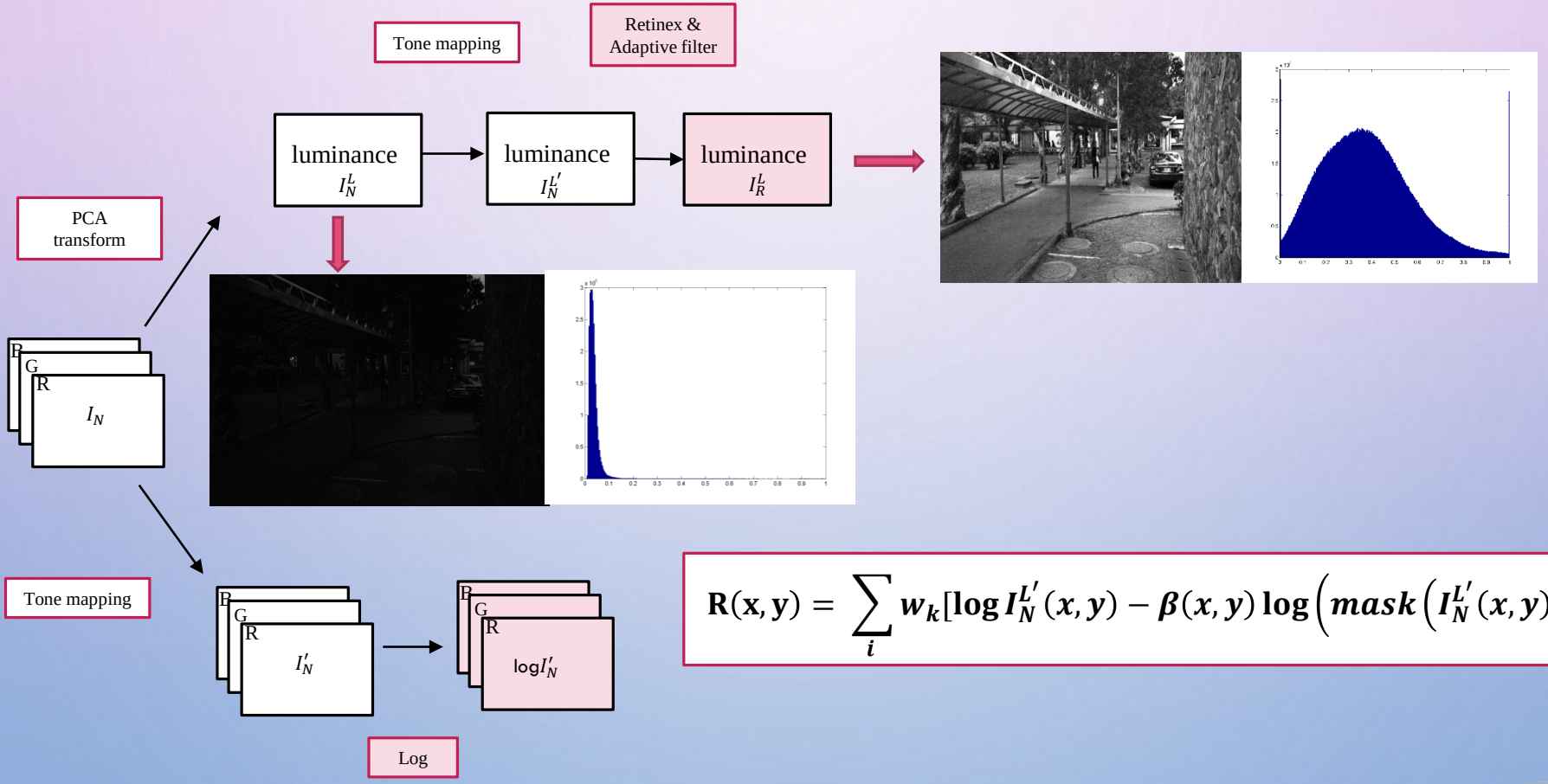


FLOW OF ALGORITHM



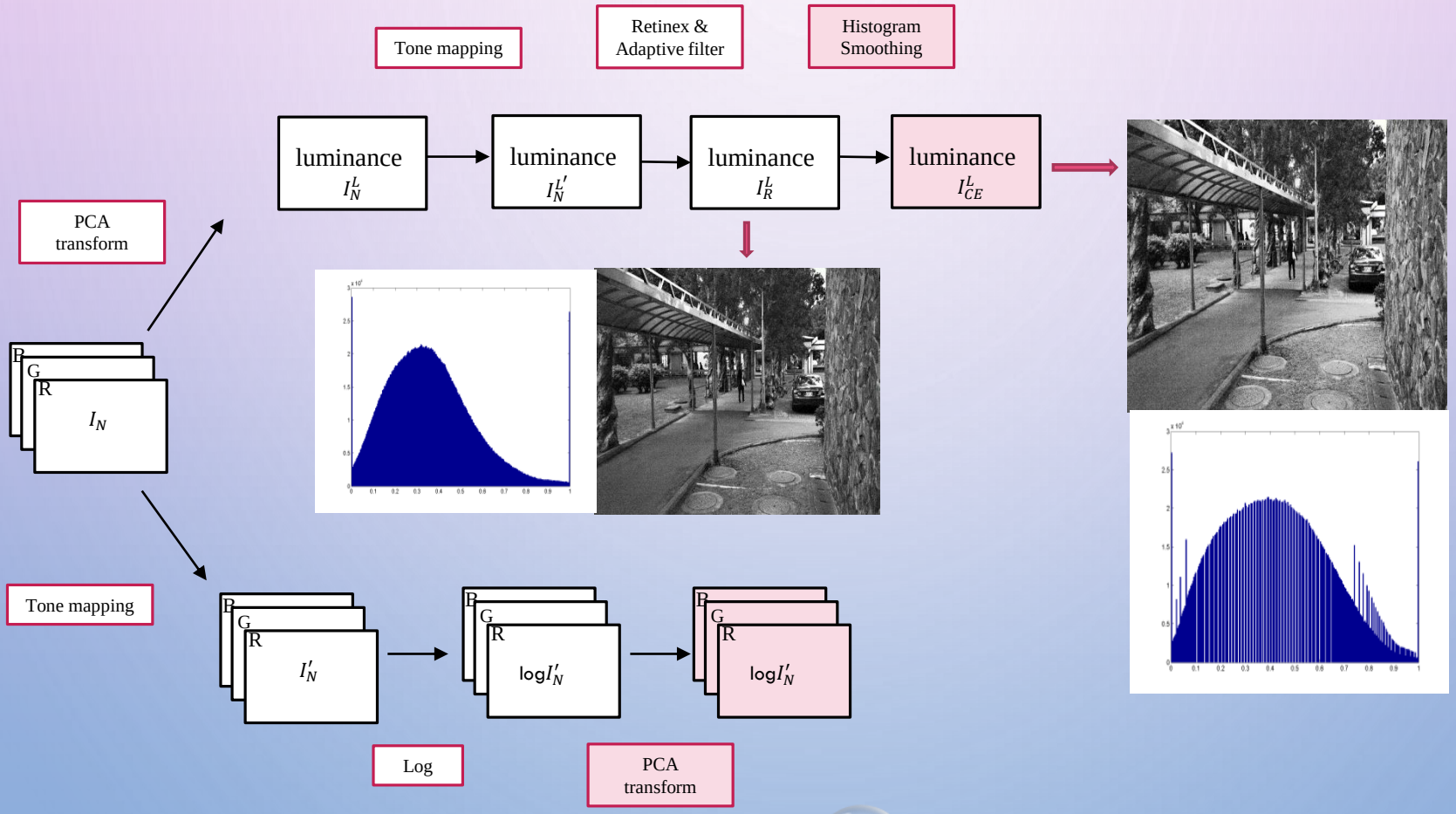
$$I_N^{L'} = (I_N^L)^{1/\gamma}$$

FLOW OF ALGORITHM

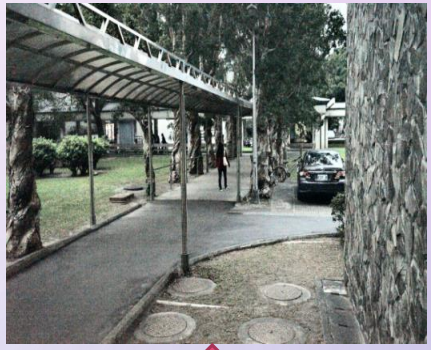


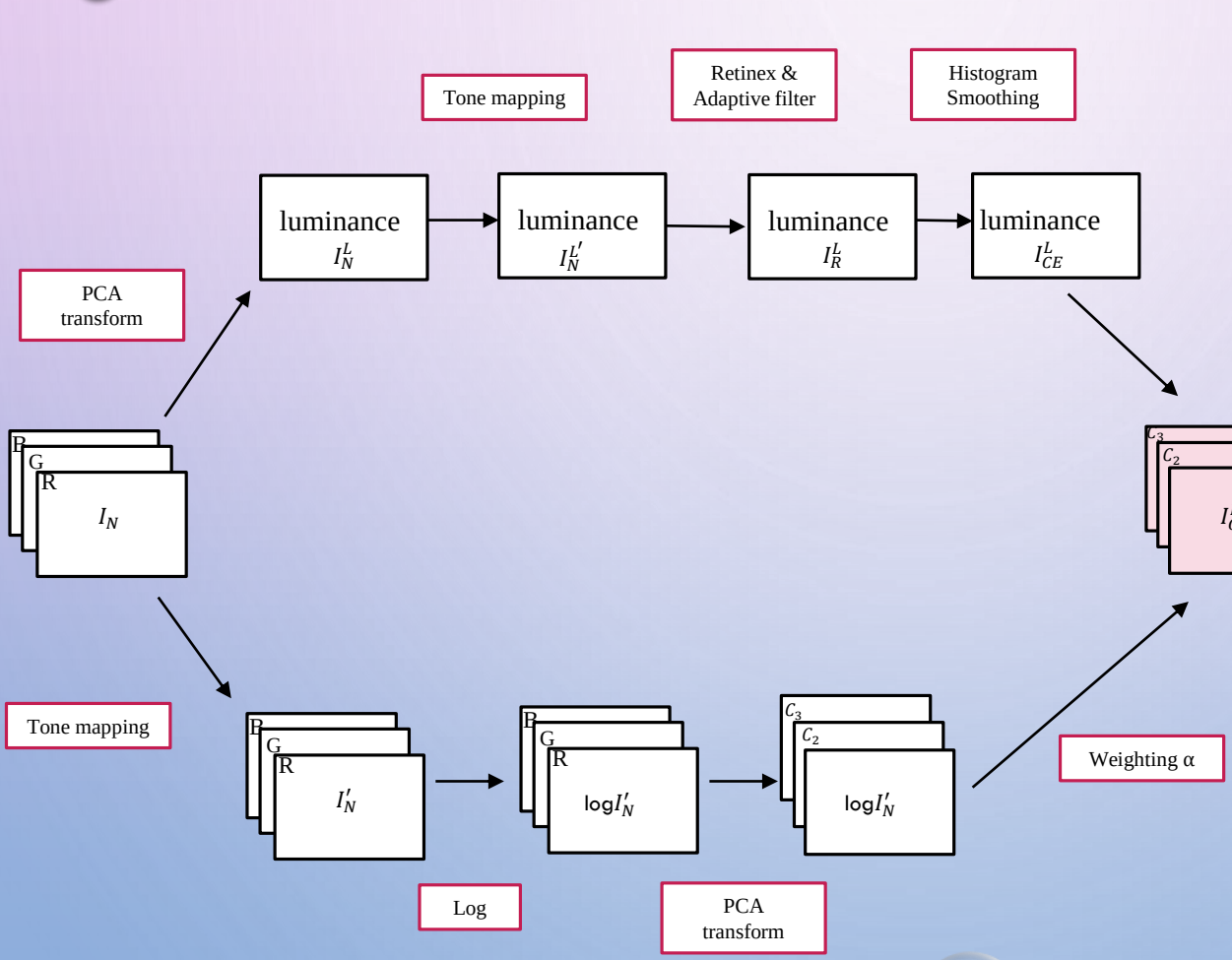
$$\mathbf{R}(\mathbf{x},\mathbf{y}) = \sum_{i} w_k[\log I_N^{L'}(x,y) - \boldsymbol{\beta}(x,y)\log\left(\boldsymbol{mask}\left(I_N^{L'}(x,y)\right)\right)$$

FLOW OF ALGORITHM

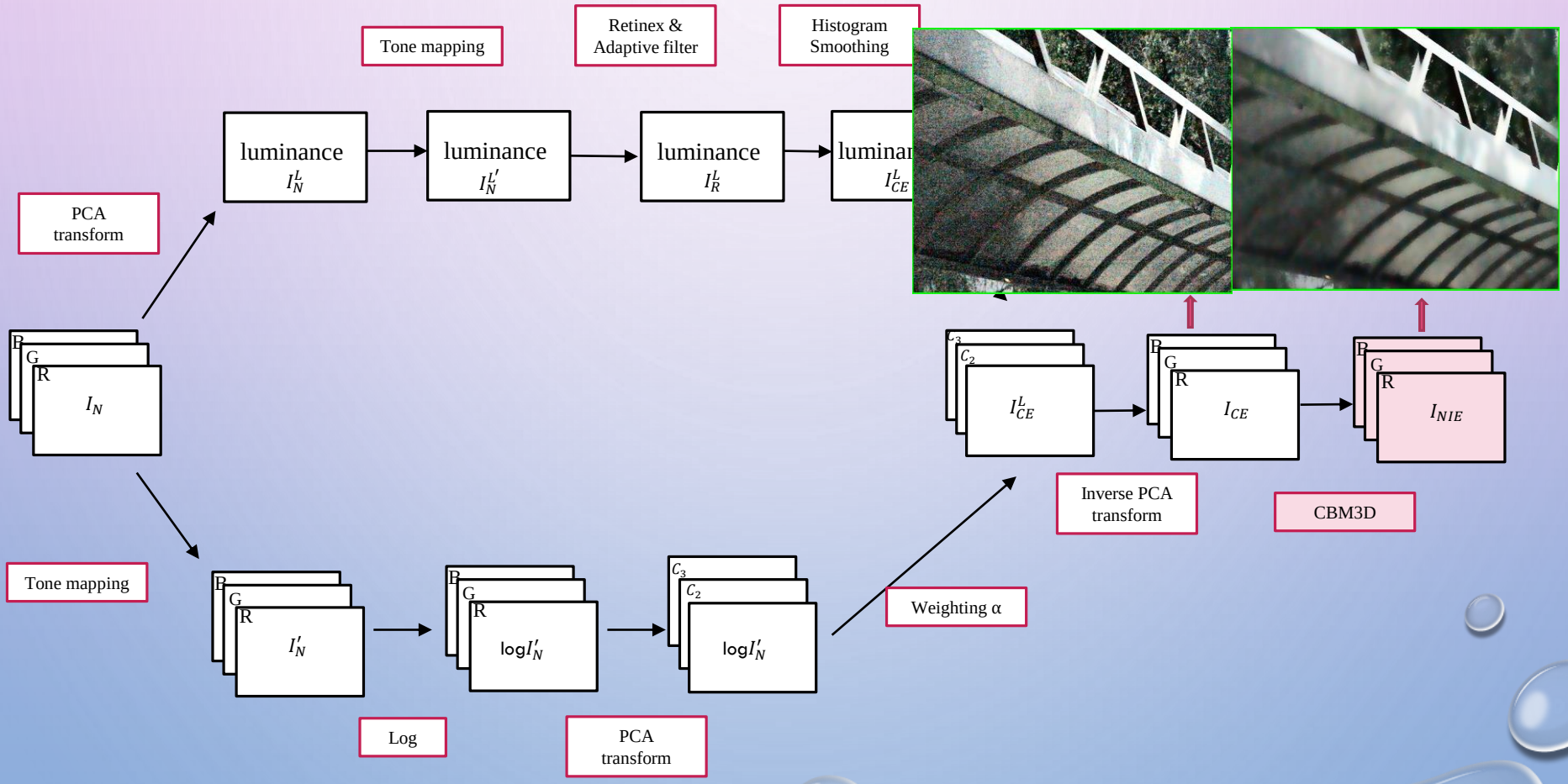


FLOW OF ALGORITHM





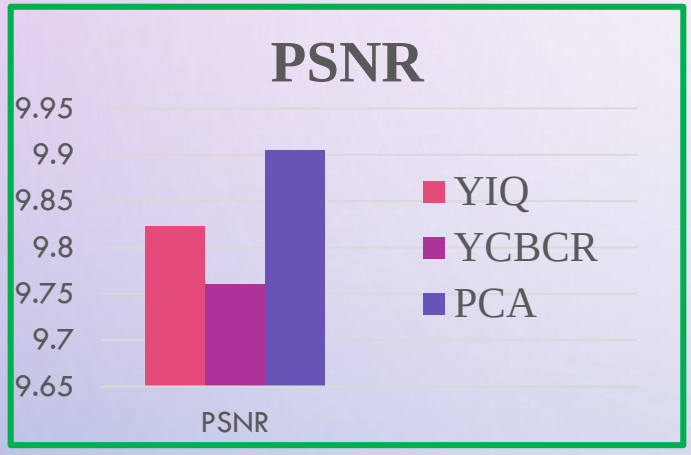
FLOW OF ALGORITHM

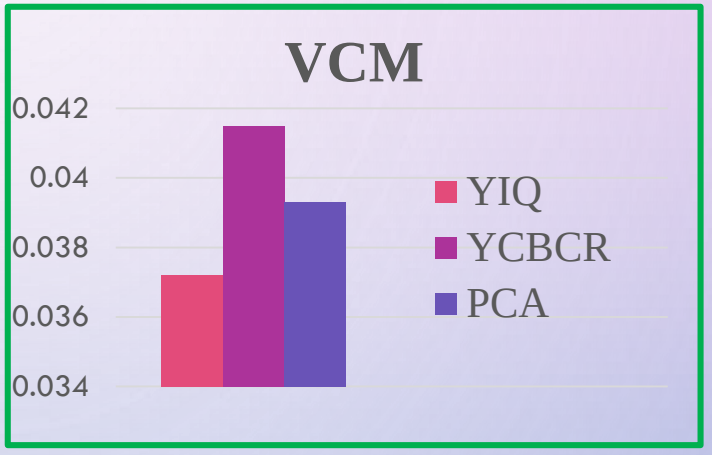


3. Results and discussions

Why PCA?

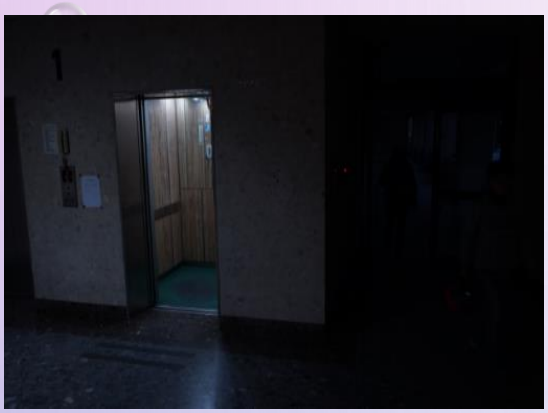
Quantitative analysis





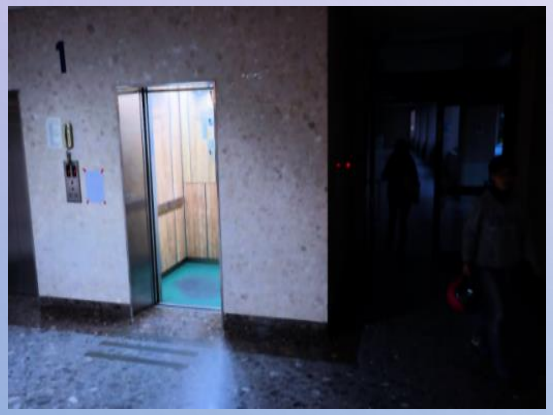
3. Results and discussions

REAL NIGHT IMAGE – INDOOR



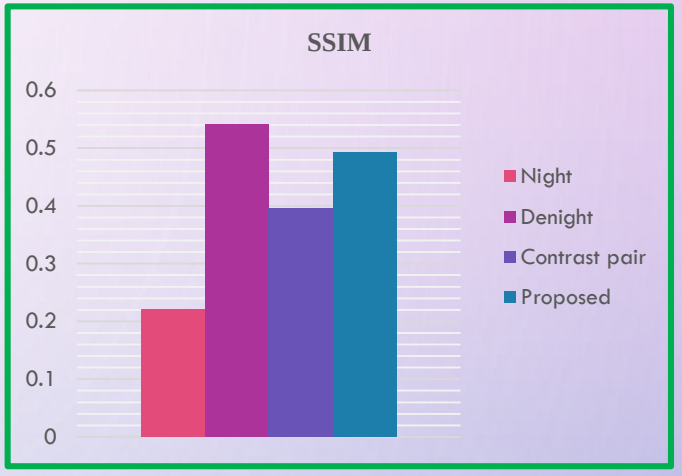
Real night image

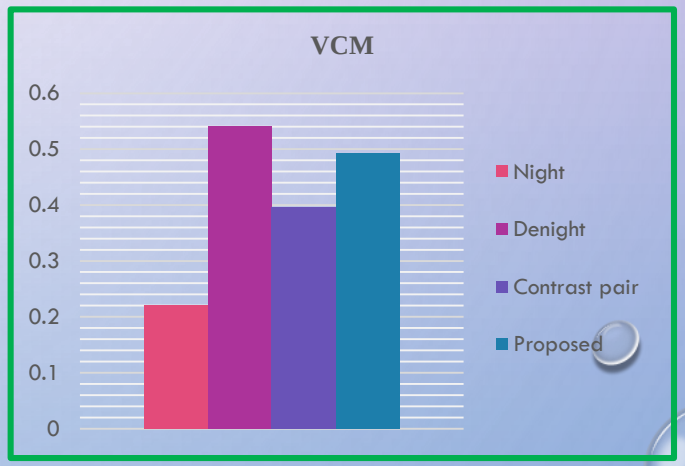
Denight



Contrast Pair

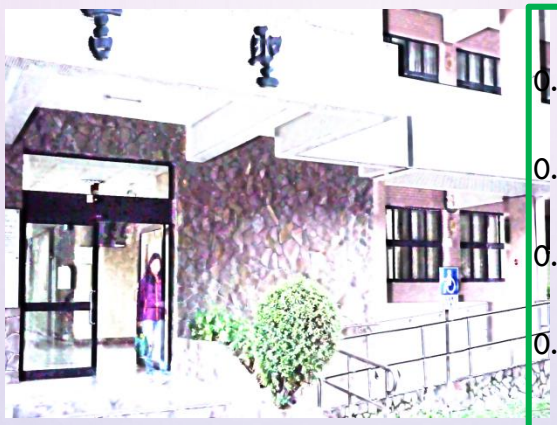
Proposed



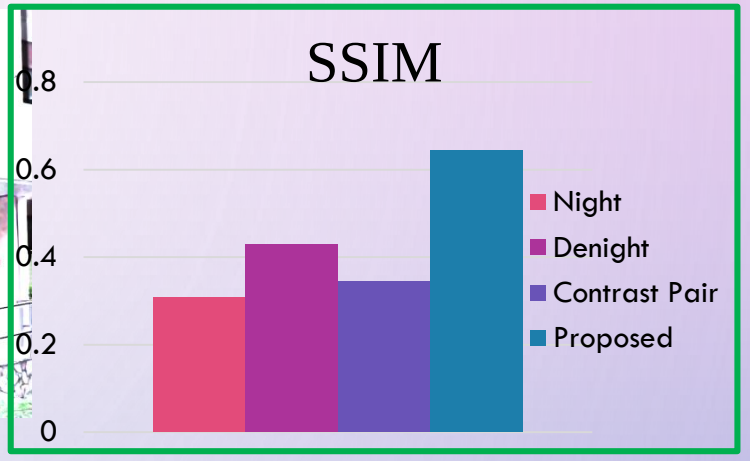


REAL NIGHT IMAGE – OUTDOOR 1

Real night image

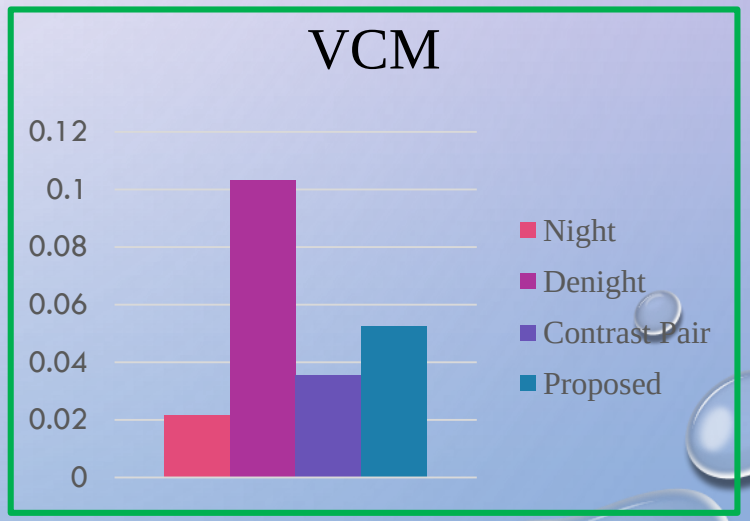


Denight

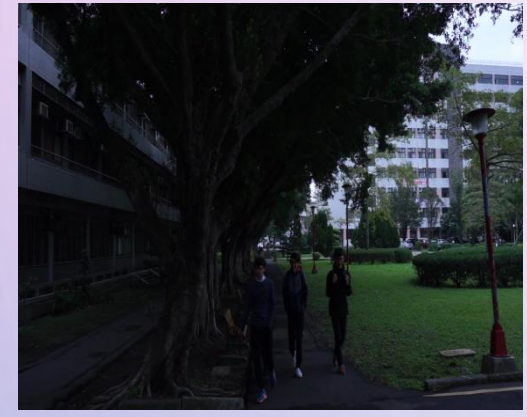


Contrast Pair

Proposed



REAL NIGHT IMAGE – OUTDOOR 2

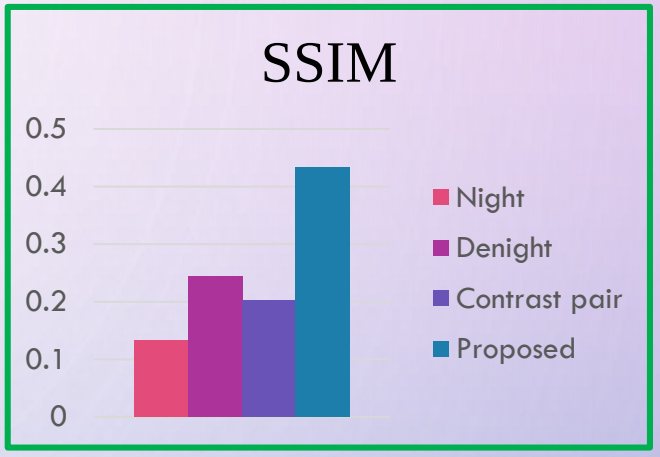


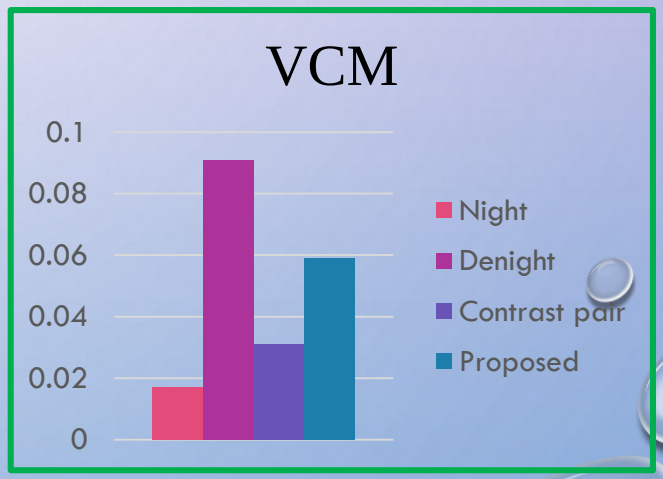
Real night image

Denight

Contrast Pair

Proposed





DENOISING

Day image with Poisson noise

Bilateral filter

CBM3D

4. CONCLUSION

- Center surround retinex based adaptive filter in three scales improves the contrast and brightness very significantly.
- Attenuates noise through collaborative filtering which reveals even the finest details of the image.
- In this method over enhancement problem is avoided and ghosting artifacts are eliminated.

THANK YOU