Demo : Zero-Reference Deep Curve Estimation for Low-Light Image Enhancement

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What is Zero-DCE?

Zero-DCE is a novel method to do light enhancement in an image. We could obtain do light enhancement in image while keep maintain the detail and preserves quality of the image

- Using common image format (.jpeg,.png,.bmp, etc.)
- No label needed (Zero Reference)
- SOTA on low-light image enhancement

Improvement

Color Correction

Fix the color issues and make footage appear as naturalistic as possible

Image Denoising

Removing noise

Training Data

Use a larger amount of training data

“Ready for Production”

Color Correction

Illuminant Estimation

Performs color balancing via histogram normalization.

1. Determine the histogram for each RGB channel and find the quantiles that correspond to our desired saturation level.
2. Cut off the outlying values by saturating a certain percentage of the pixels to black and white.
3. Scale the saturated histogram to span the full 0-255 range.

Input

Low Light

Zero-DCE

Too Vibrance

Zero-DCE + Color Correction

Color Balancing

Limare, Nicolas & Lisani, Jose-Luis & Morel, Jean-Michel & Petro, Ana-Belen & Sbert, Catalina. (2011). ***Simplest Color Balance.*** *Image Processing On Line. 1. 10.5201/ipol.2011.llmps-scb.*

Image Denoising

Algorithm: **Non-local Means Denoising**

OpenCV implementation based on Buades, Coll, Morel (2005)

The ideas

1. Assume that the noise is a random variable with zero mean
2. One can get the noise by averaging the differences between many similar image sequences
3. In the case of single image, calculate the mean of all image patches which are similar and redundant

Noisy

Restored

Source:
Buades, Coll, Morel (2005)

Retraining Complete Dataset

Since Original Zero-DCE just use first part of SICE Datasets.

We tried to retraining using second part of the datasets (Complete Dataset).

Add Our Own Dataset

Taken with

Fujifilm XT-100

Taken with

Nikon D5300

We add around 190 Photos, with 38 Different Scenes inside NCTU Campus

Photo Result

ED : Extend Dataset
CC : Color Correction
D : Denoise

Video Demo

Underexposed Camera Footage

Enhanced with ZeroDCE ED + CC + D

ED : Extend Dataset
CC : Color Correction
D : Denoise

Implementation (photo)

Real-time photo demo

Capture real-time Image using DSLR Camera

Capture from DSLR using gPhoto2 and Node-RED (using the lowest ISO)

+

DCE-Zero Network

Enhance the image with extended SICE dataset using Zero-DCE Network

+

Color Correction + Denoising

Do the color correction from output of Zero-DCE network and do denoising to enhance the quality of picture.

→

Result

Real time light enhancement image from DSLR Camera. This is really useful for entry-level camera to perform well in low light without high-spec sensor capability.

Zero DCE Limitation

INPUT

Zero DCE
OUTPUT

Can’t
Handle
Too dark
And noisy

Not
Adaptive

Thank You!