Dancing In the Dark

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Abstract

Edge detection of images in lowlight is challenging due to their low photon counts and low Signal-Noise Ratio. RAW data which is richer in information than popular RGB format is thus valuable in this task. And baisc U-Net structure is proved to have significant performance on low light enhencement task. In our work, we proposed **U-NeXt**, a model improved from U-Net for eadg detection of images in low light using RAW data. In summary, the contributions of our work are:

- Propose U-NeXt and compare its performance with state-of-the-art model DexiNed.
- Explore several key components that contribute to the performance difference along the way.

Motivation

Problem Existing edge detection models have poor performance on images in low light.

Data Format The RAW data is recorded directly from the light information that the image sensor captures. It is where other formates of image come from, thus has retained more information.

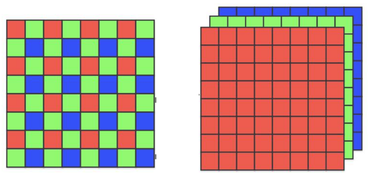


Fig 1. Illustration of RAW image (left) and RGB image (right)

Model Selection U-Net works directly on RAW data is proved to outperform the traditional pipeline in image enhencement [1], which gives us insight on edge detection task. Also, pure ConvNet structure can be gradually modified to achieve a better performance than other models [2]. So a modification from U-net model is worthy to try.

Reference

[1] Chen, Chen, et al. "Learning to see in the dark." Proceedings of the IEEE conference on computer vision and pattern recognition. 2018.

[2] Liu, Zhuang, et al. "A convnet for the 2020s." Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition. 2022.

Pipeline and U-NeXt

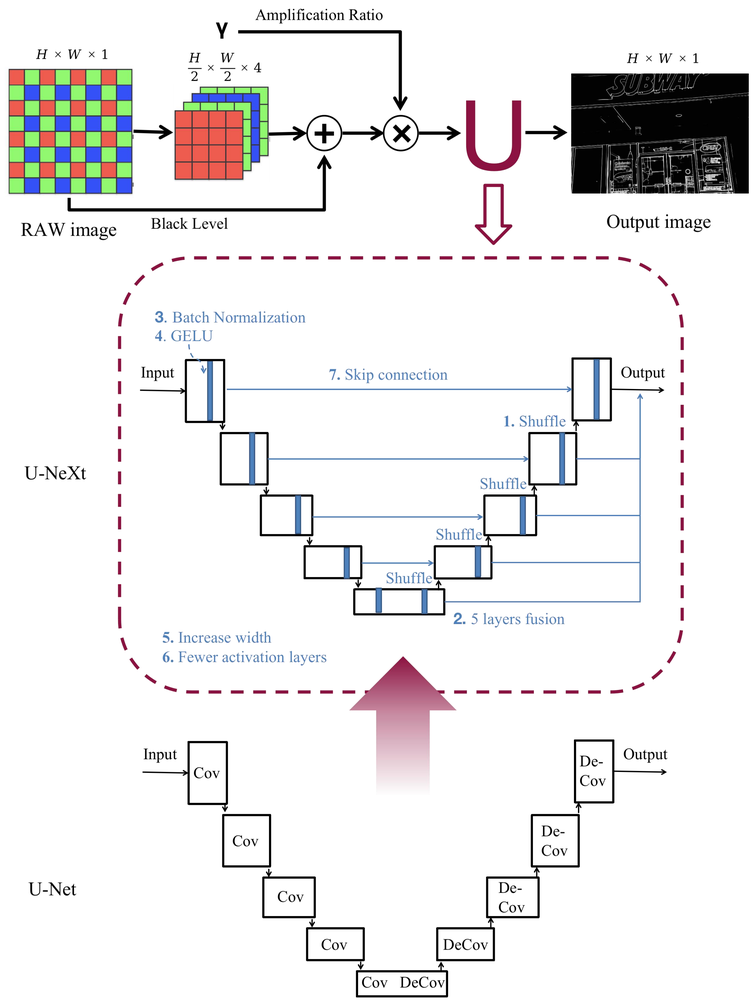


Fig 2. Illustration of the whole pipeline (top) and U-Next structure. Words in blue demonstrate the modification.

Conclusions

- U-NeXt is an effective model for edge detection of RAW imges in low light, with a performance improvment of 9.1% from state-of -the-art model DexiNed.
- Macro modifications like pixel shuffle, width, skip connection and coupled micro modifications like fusion+BN can greatly improve the performance of U-shaped CNN.

Experiments results

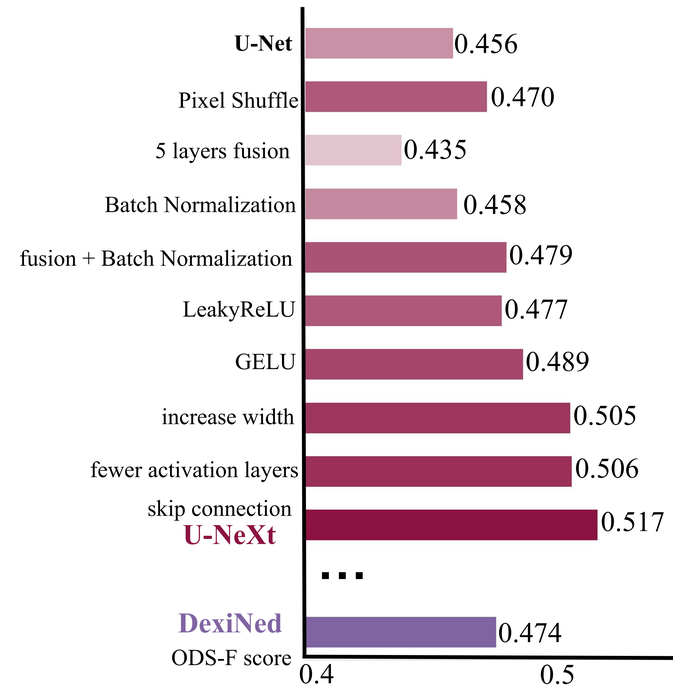
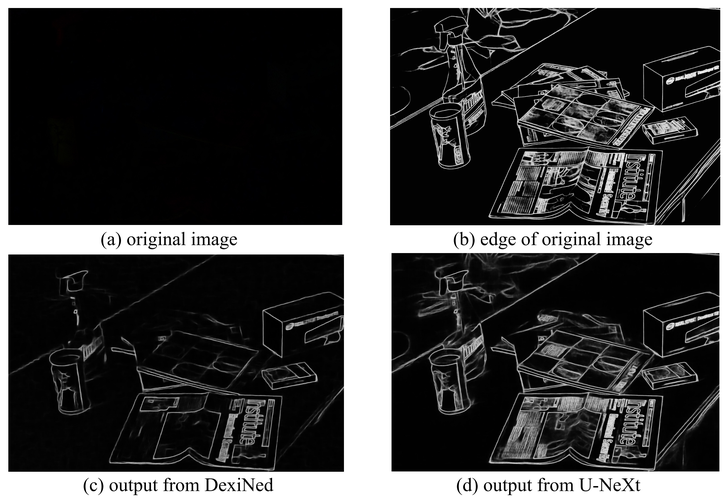


Fig 3. Modifications from U-Net to U-NeXt with corresponding performance, and compare it with state-of-the-art model DexiNed.



(a) original image (b) edge of original image

(c) output from DexiNed (d) output from U-NeXt

Fig 4. Edge detection results.

https://www.aliyundrive.com/s/fqscmgxuUEn

A funny demo video is here for you !