

## 11 Emulate the effect of highlight diffusion filter



Fig. 12: The highlight diffusion filter creates a blooming effect around highlight areas, giving the image a smoother, more artistic look (Image source: [1]).

*Description:* Different filters are developed for cameras to produce various artistic styles, such as highlight diffusion filters. A highlight diffusion filter softens bright light sources, creating a blooming effect while giving the image a smoother, more artistic look, as shown in Figure 12. This project aims to digitally replicate the effects of this filter, transforming standard photos into visually expressive, stylized images.

### *Tasks:*

- Data acquisition: collect a dataset of image pairs captured with and without filters. Ensure precise alignment between filtered and unfiltered images to serve as high-quality training data.
- Develop two ways to emulate the effects and compare the results:
  - Physics-based way: apply predefined kernels (e.g., Gaussian kernels) to convolve input images and replicate the filter effects. You should explore the relationships between the kernel sizes/shapes and the light intensity, etc.

- Deep learning-based way: train neural networks on paired data to learn the optimal kernel shapes and sizes. Develop a strategy to adaptively apply suitable kernels to different regions of an image for a realistic effect.
- Combine multi-exposure images for improved results: In long-exposure images, highlight regions often become saturated and lose precise intensity information. By incorporating a corresponding low-exposure image, the true intensity values can be better estimated. This allows for more accurate application of appropriate kernels in these regions, leading to improved visual effects.

*Prerequisites:* Basic knowledge of image processing. Strong programming skills, with familiarity in deep learning frameworks such as PyTorch. Familiarity with basic operations for capturing photos using digital single-lens reflex (DSLR) cameras.

*Learning objectives:* Lens filter emulation, Image style reproduction.

*Deliverables:* Code, well cleaned up and easily reproducible. Written Report, explaining the literature and steps taken for the project.

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## References

1. Samuel Lintaro Hopf. Ricoh gr iii & iiix hdf launch, 2024. <https://www.lintaro.de/work/ricoh-gr-iii-hdf/>