

# High Dynamic Range Photography Techniques For Exterior Scenes

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## 1 Introduction

HDR (High Dynamic Range) images are the result of capturing a series of X images at different exposures to accurately recreate the full range of luminosity of a scene. HDR images enable researchers to study how people experience visual comfort in interior spaces with outdoor views. To carry out this type of simulation, it is therefore essential to take HDR images of the exterior as seen from a building facade. However, taking HDR images of an exterior view presents a major issue known as "Luminous Overflow". When the sun appears in a scene, it is not possible to capture the full range of luminosity, resulting in white pixels on the image.

To address this issue, we undertook to develop a methodology using a new tool called "Shadowband" (Figure 1.) to capture HDR of outdoor scenes from a facade. We measured the effectiveness of this method by building up a dataset of high dynamic range images for daylight research.

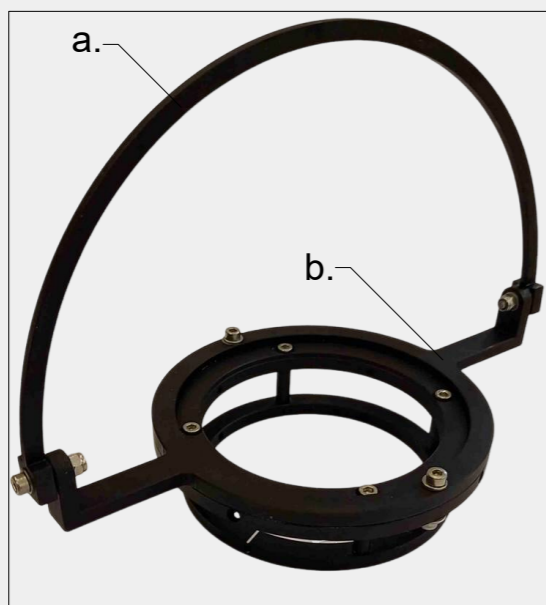


Figure 1. Shadowband is a tool for shooting HDR with the sun in the field of vision. Its purpose is to block the sun. The half-circular arc (a.) can block the sun both vertically and horizontally, by rotating around the first ring (b.).

## 2 Materials

1. Canon EOS 70D
2. SIGMA 4.5mm 1:2.8 fisheye lens
3. Tripod
4. Illuminance meter LMT
5. Lux Meter
6. ND3 filter
7. Tweezers
8. Shadowband

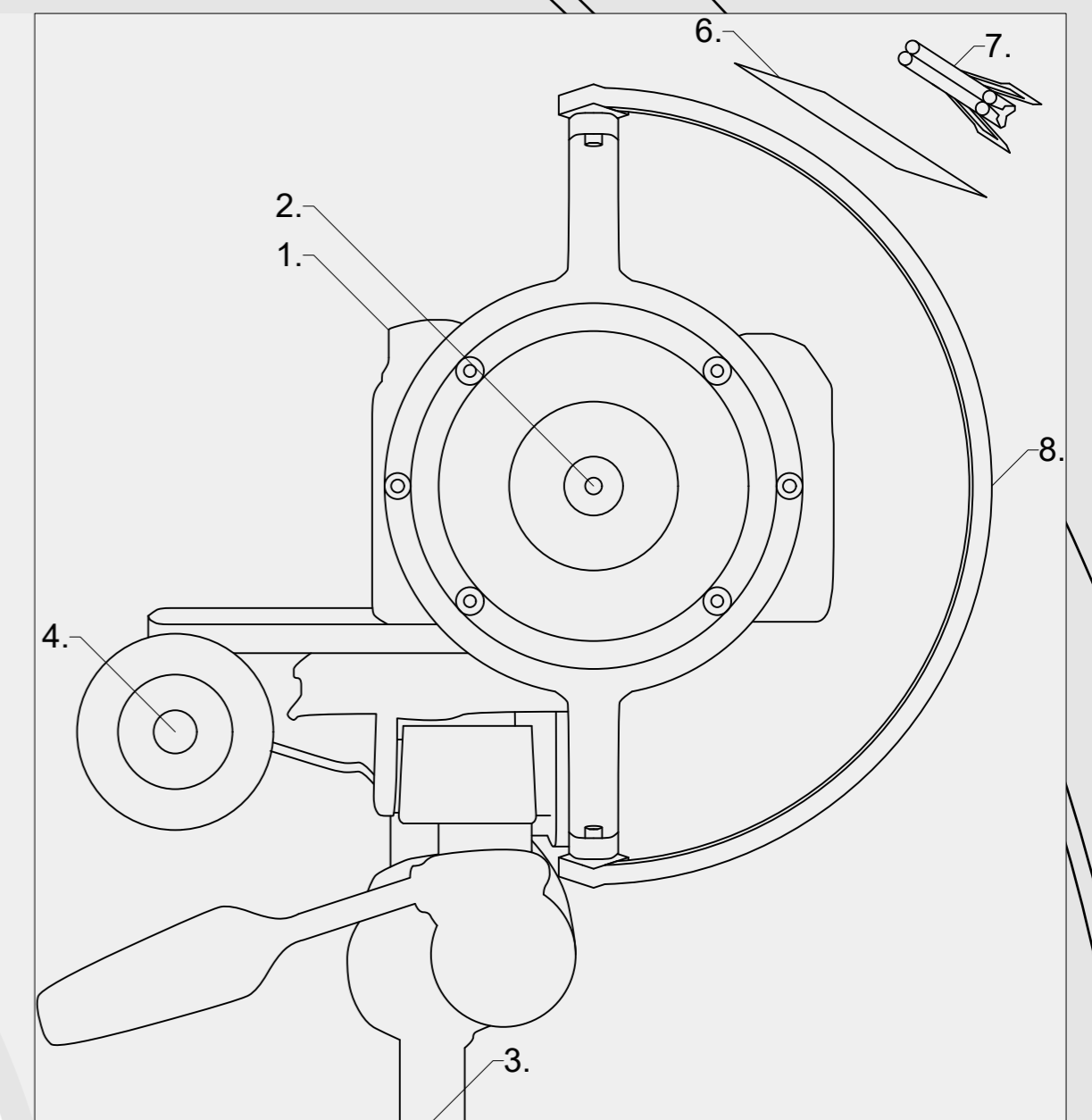


Figure 2. Equipment used to capture HDR images.



## 3 Method Overview

- Initial camera setup, ND3 filter on vertical arc with sun in the filter's center. (Figure 3., Step 1.)
- Recording of the illuminance values with a LMT meter before capture. (Step 2.)
- Capture of three image sequences with varying settings. (Steps 3.-7.)
- Post-capture data collection includes LMT meter and portable LUX meter values. (Steps 8./9.)
- Development of the three sequences taken into HDR images. (Figure 5.)

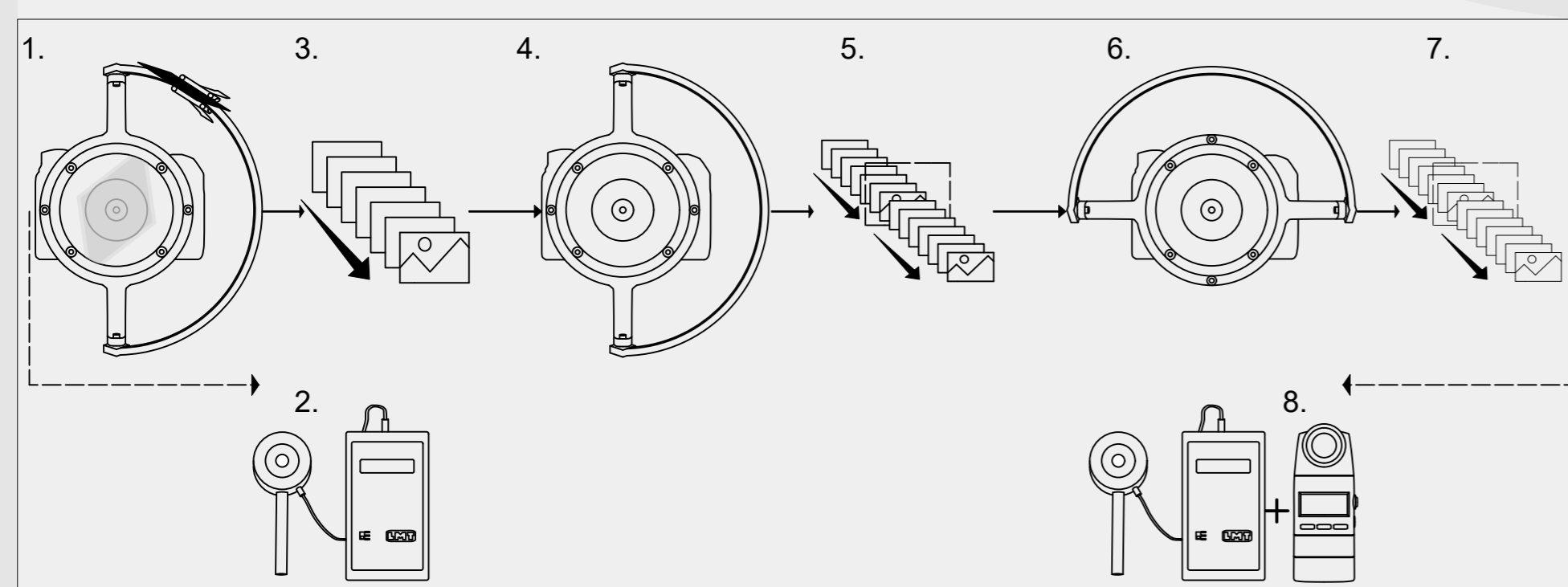


Figure 3. Diagram of the methodology developed using the Shadowband tool.

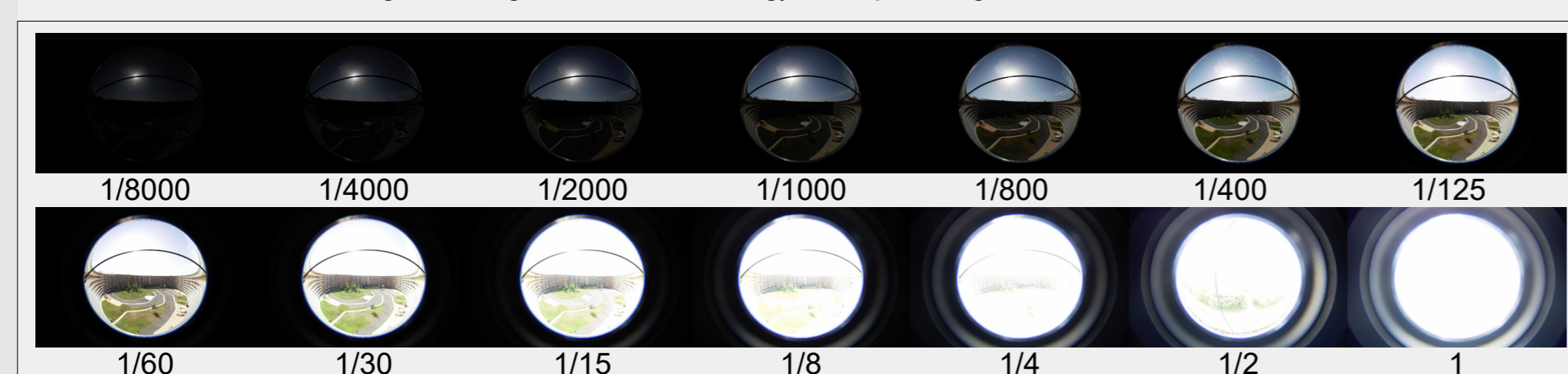
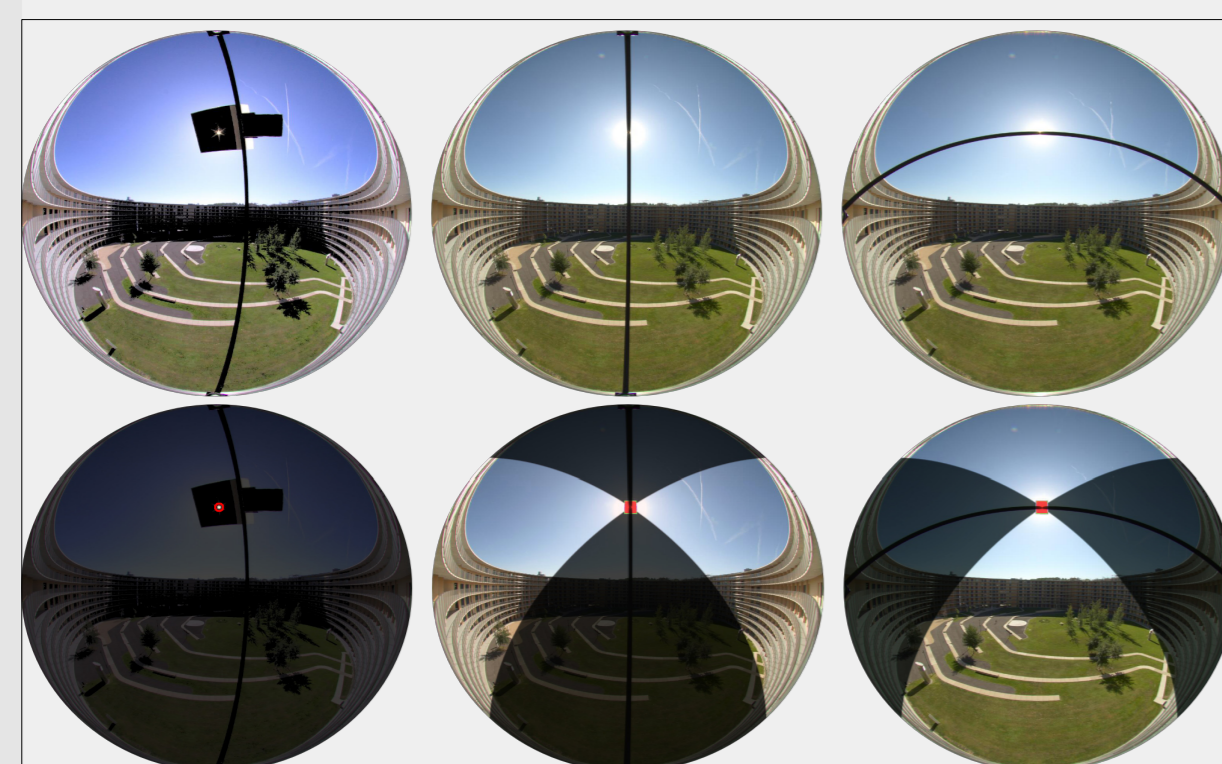


Figure 4. Example of step 7 (Figure 3.) with a sequence of 14 images ranging from an exposure of 1/8000 to 1 second.



- The black areas are subtracted and the remaining parts of the vertical and horizontal images are combined to reconstruct the scene.
- The red zones extract the sun to recreate a sun without the overflow.

Figure 5. Development of the 3 final HDR (ND3, Vertical, Horizontal) using the Pylinearhdr script.

## 4 Results and Conclusion

- The methodology developed produced a dataset of 278 images.
- 152 of these images show the sun and were obtained using the Shadowband.
- The main limitation of this research is the fluctuating lighting conditions, which affect around 39% of the images, with other factors also contributing to this percentage.
- The Shadowband tool and the methodology developed allow to capture HDR images with the sun without overflow. The Shadowband tool is effective for capturing reliable images.



Figure 3. Part of the 248 captures of the dataset represented geographically on QGIS (geographic information system software)

## 5 Key Takeaways

The strength of the Shadowband is that it is **practical, fast and accurate** to adopt. Although this is an early version of the tool, the Shadowband helps to control the risk of overflow and is a reliable way of delivering HDR with the sun in the field of vision.

The Shadowband and the methodology developed **improve the imagery of simulations** in daylight and vision research by capturing the sun. In addition, the study shows that we have the right tools to integrate HDR images as a **tool of application** in other fields such as facade design in architecture.

## References

- Jakubiec, J.A., Inanici, M.N., et al. (2016) "Improving the accuracy of measurements in daylight interior scenes using high dynamic range photography".
- Ko, W.H. (2017) "Building envelope impact on human performance and well-being: experimental study on view clarity".
- Pierson, C.L. et al. (2020) "Tutorial: Luminance Maps for Daylighting Studies from High Dynamic Range Photography," LEUKOS the Journal of the Illuminating Engineering Society.