Practical and comprehensive lighting quality measurements using IoT

Practical and Comprehensive Lighting Quality Measurements using IoT

Thijs Kruisselbrink*
Rajendra Dangol,
Alexander Rosemann

Department of Built Environment
Building Lighting Group

* t.w.kruisselbrink@tue.nl

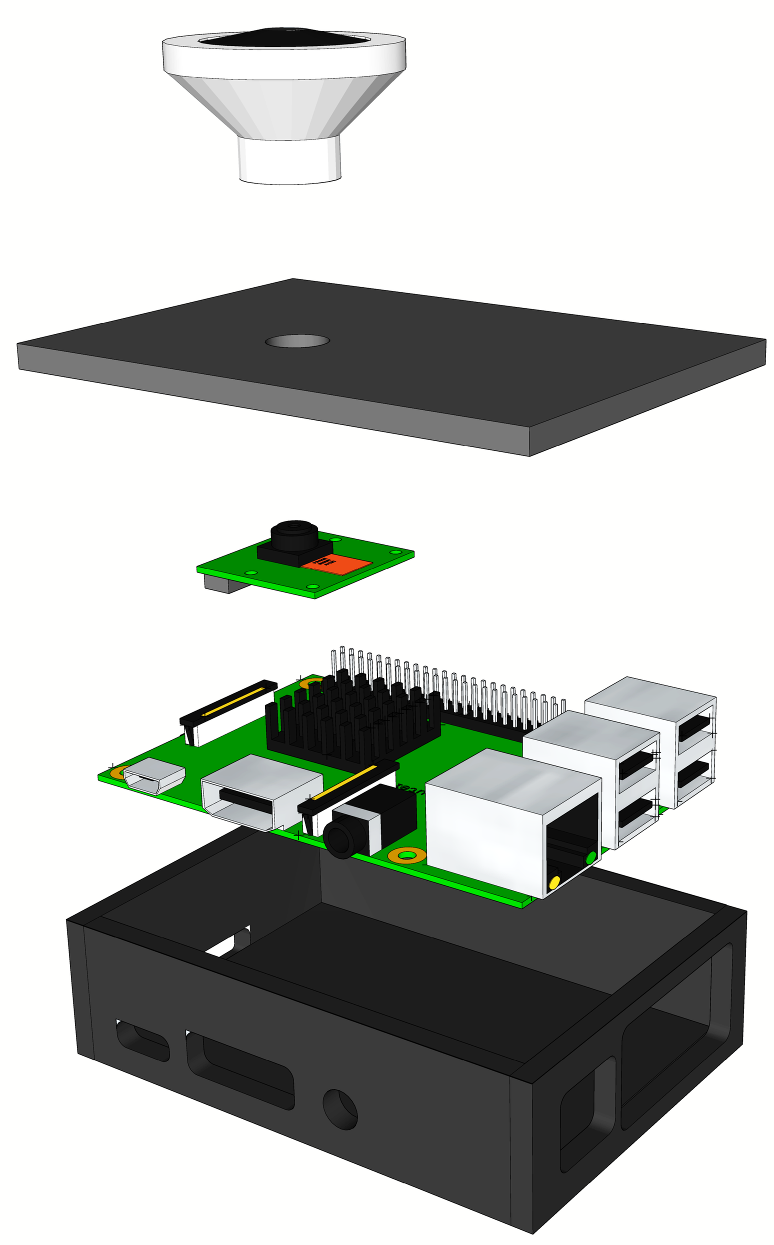
Introduction

- Part of the interdisciplinairy project: ***OptiLight - Mathematical Optimizations for Human Centric Lighting***.
- Despite growing understanding of the impact of light on wellbeing, performance and circadian rhythms, benefits of this understanding cannot (yet) easily be harvested in practical systems.
- Scalable algorithms are lacking that can be used in automated systems.
- There exists a huge gap between results obtained in controlled environments and practical deployment.

- This project aims to measure lighting quality in a practical and unobtrusive manner using an IoT luminance distribution measurement device.
- "Good-quality lighting is lighting that allows you to see what you need to see quickly and easily and does not cause visual discomfort but raises the human spirit"[1]

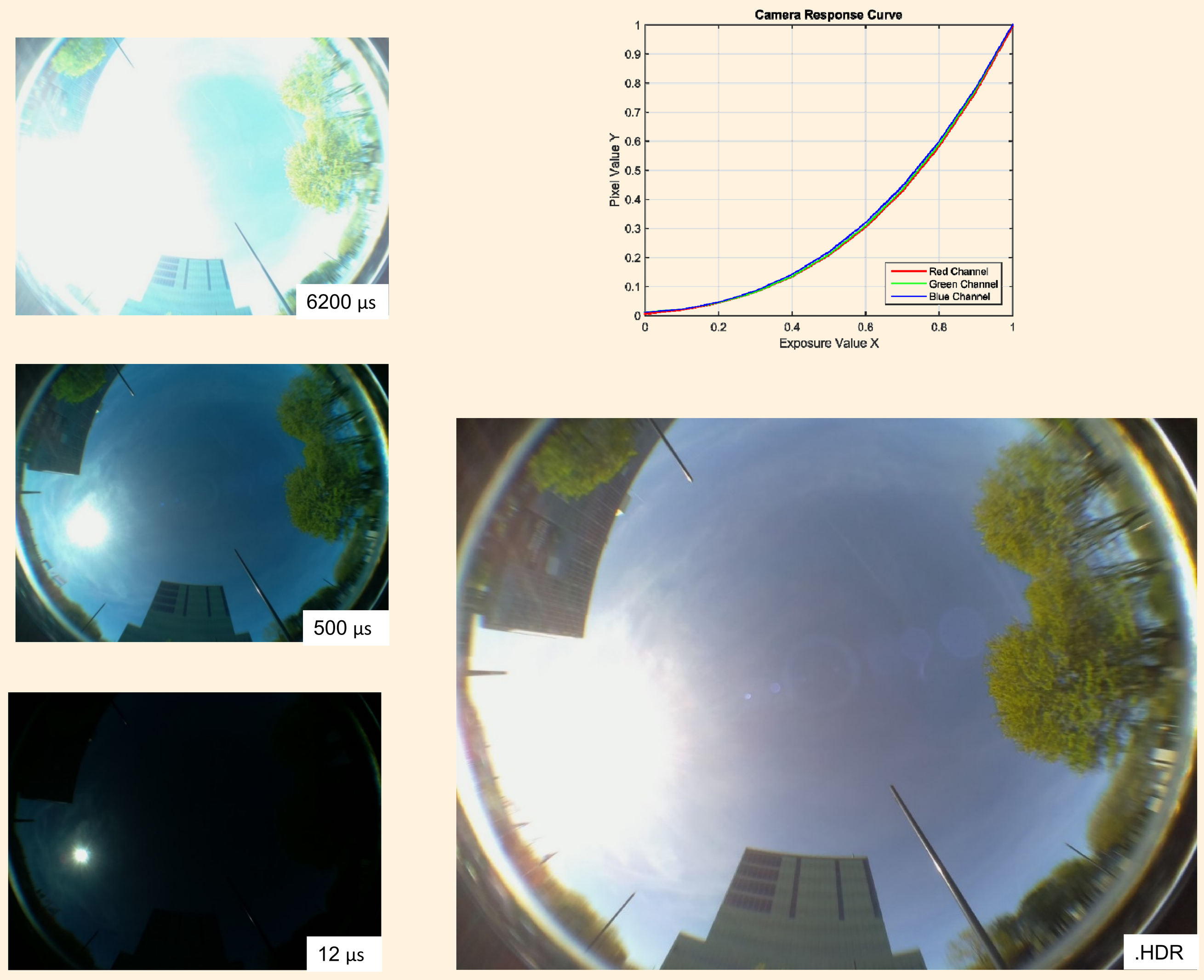
I. The Bee-Eye: An IoT-Device for Measuring the Luminance Distribution[2]

Low cost components:
Single board computer
Camera
Fisheye lens



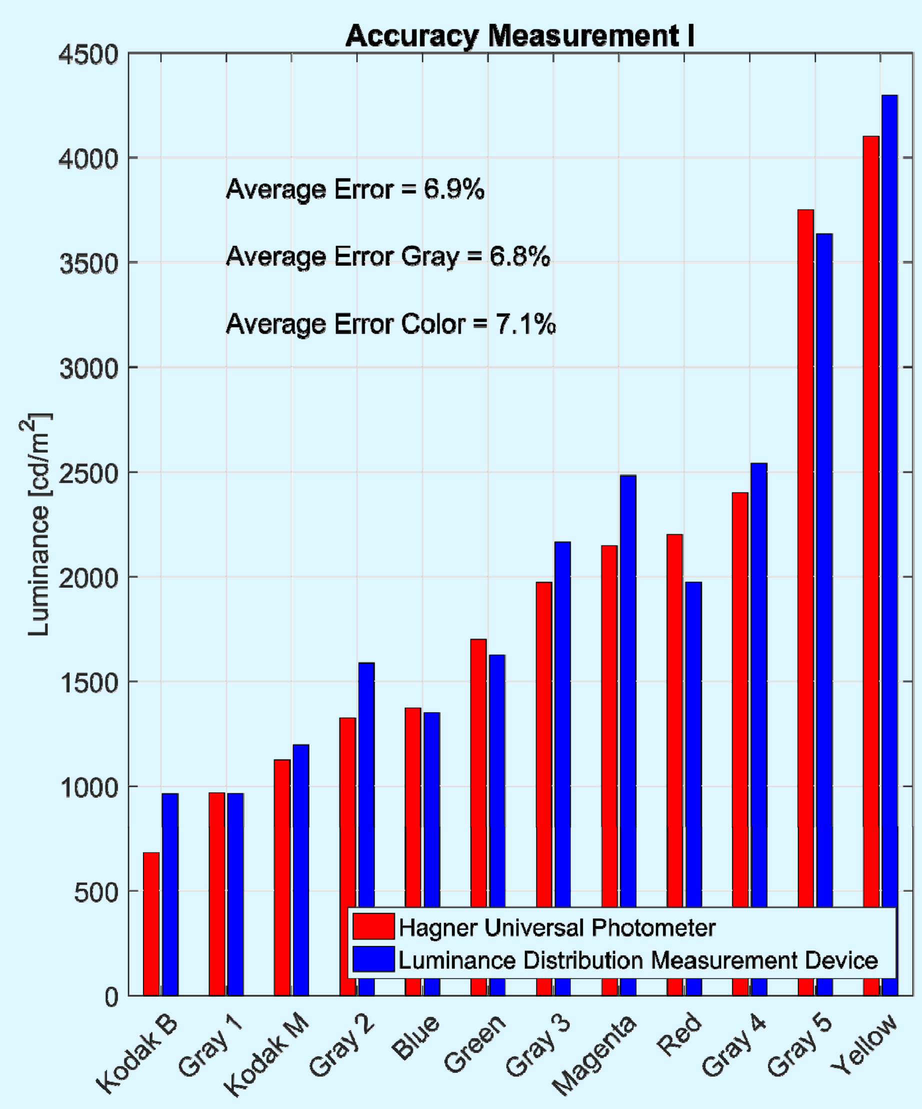
High Dynamic Range (HDR) technology is required to capture contrasts occuring in real world.
HDR images are formed based on:

- 7 exposures with shutterspeeds ranging from 250,000 to 12 μs
- Specific camera response curve by radiometric self-calibration



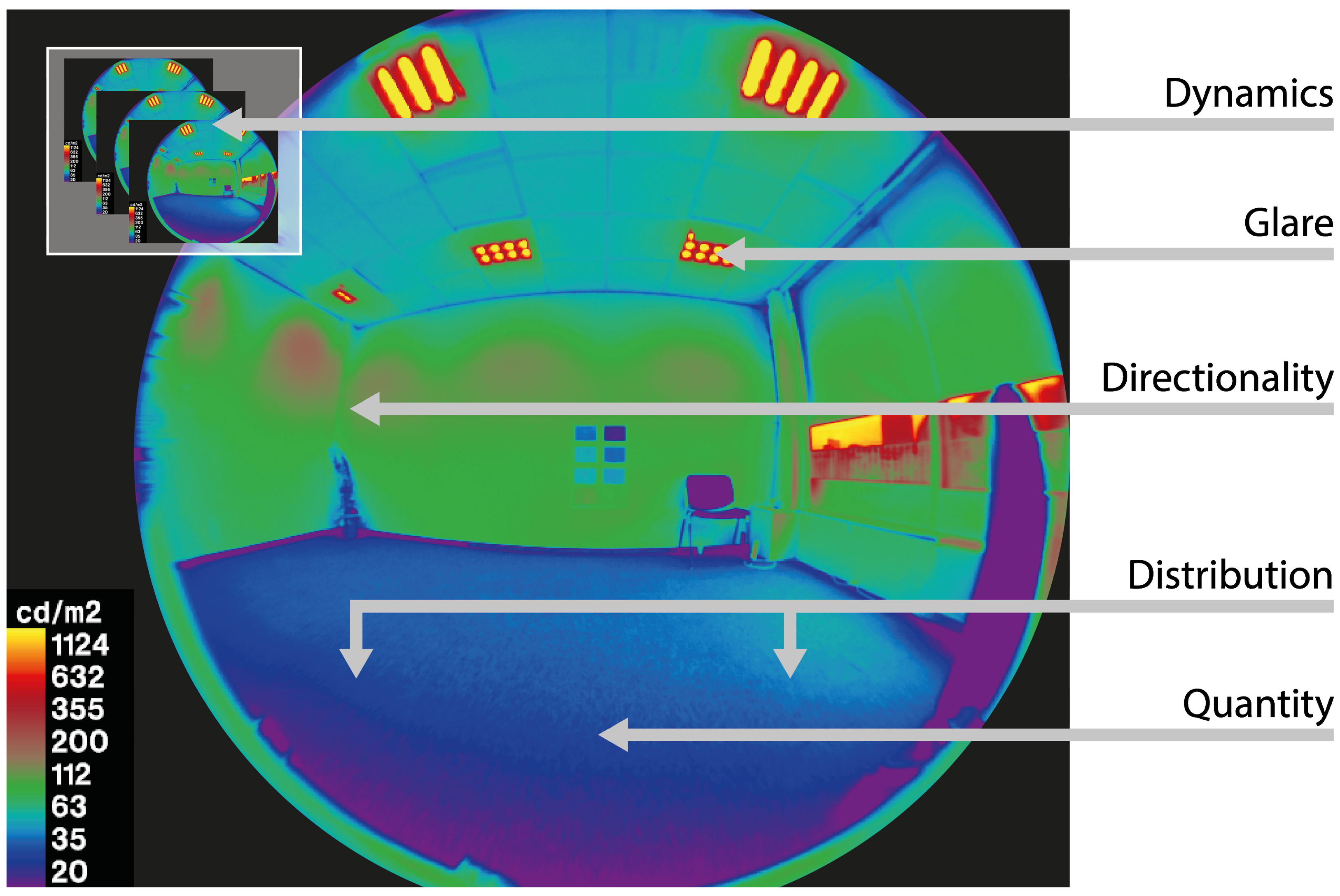
Specifications

- The accuracy stays within 3.0% to17.5%.
- Autonomous, Calculation time = 35 s.
- Measurement period = 8 s.



II. Measuring Lighting Quality[3]

Algorithms aim to optimize variable lighting quality aspects, indicated in green. Except the spectral power distribution (SPD) all aspects can be measured by the Bee-Eye. Hence, the Bee-Eye is an effectice Lighting Quality measurment Device



[1]P.R. Boyce, Human Factors in Lighting, third edit, CRC Press, 2014.
[2]T. Kruisselbrink, M. Aries, A. Rosemann, A practical device for measuring the luminance distribution, Int. J. Sustain. Light. 36 (2017) 75–90. http://lightingjournal.org/index.php/path/article/view/76.
[3]T. Kruisselbrink, R. Dangol, A. Rosemann, Photometric measurements of lighting quality: An overview, Build. Environ. 138 (2018). doi:10.1016/j.buildenv.2018.04.028.