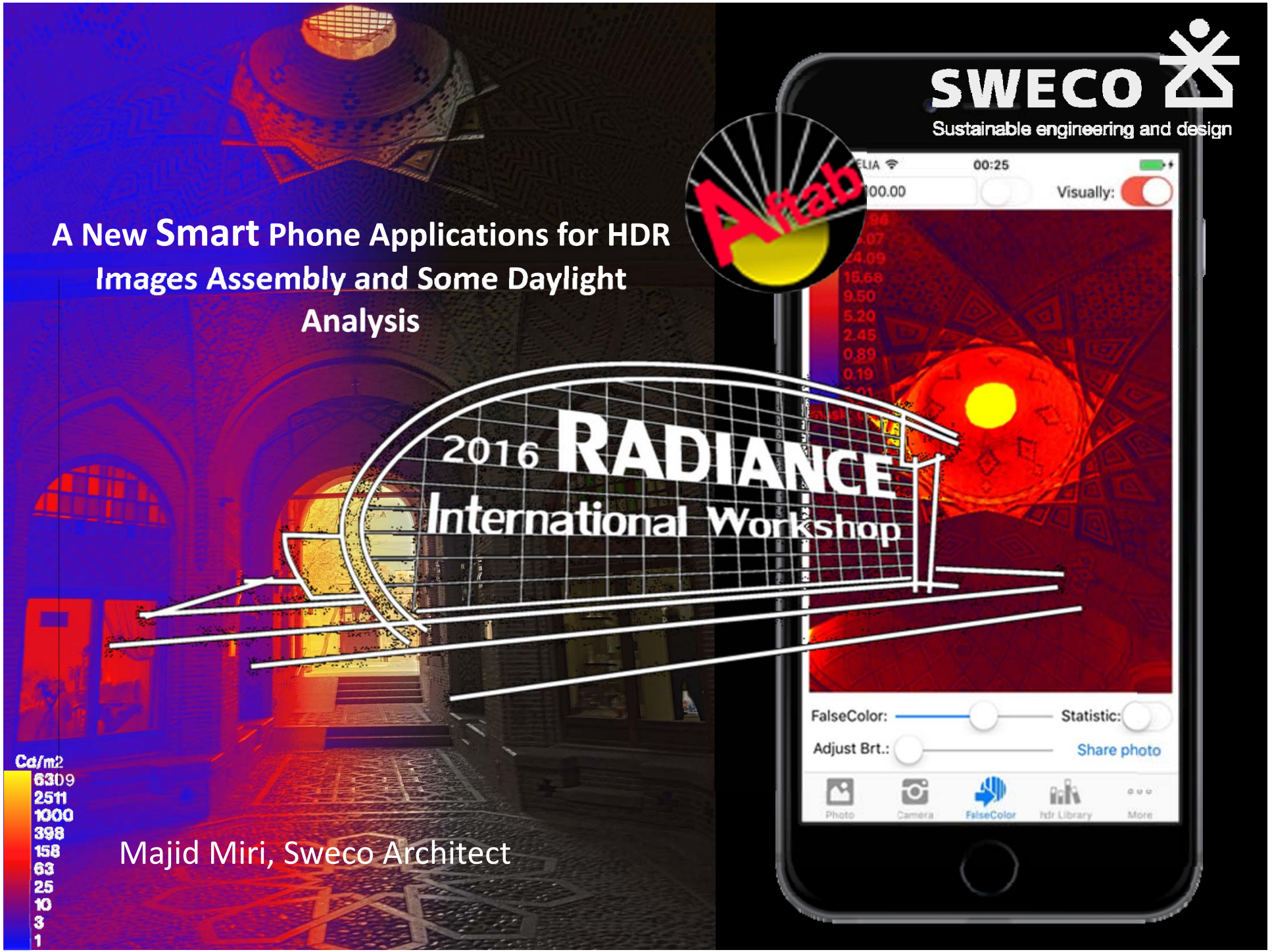
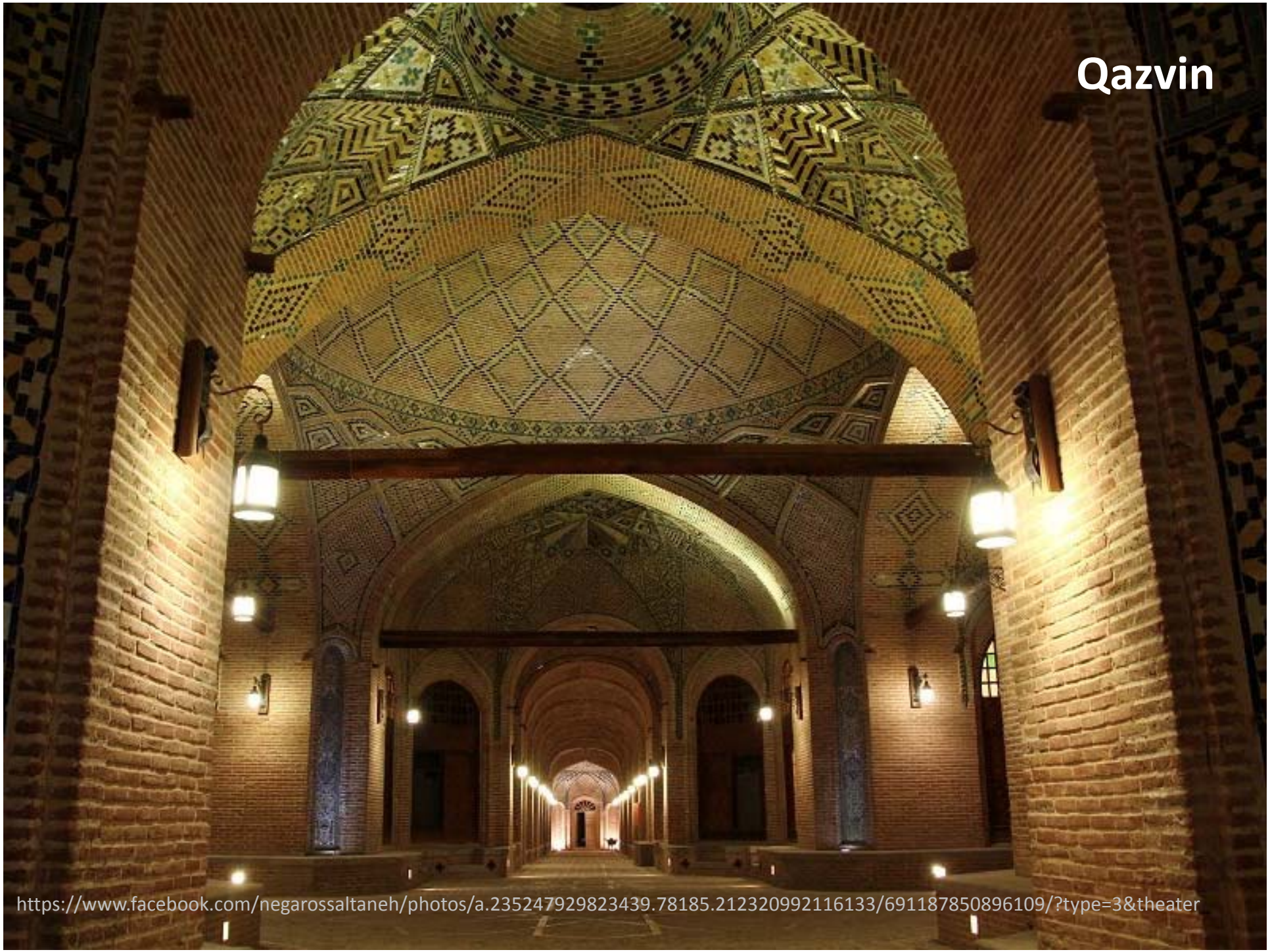
A New Smart Phone Applications for HDR Images Assembly and Some Daylight Analysis



Majid Miri, Sweco Architect


Qazvin
https://www.facebook.com/negarossaltaneh/photos/a.235247929823439.78185.212320992116133/691187850896109/?type=3&theater

Low Dynamic Range (LDR) images

Since all regular cameras have limitations in that they cannot capture a large dynamic range of luminance in a realistic scene,

or

High Dynamic Range (HDR) images

Since all regular cameras have limitations in that they cannot capture a large dynamic range of luminance in a realistic scene, we need to assemble a sequence of LDR (low dynamic range) photos taken by them to create a HDR (high dynamic range) image which includes the whole range.

or

High Dynamic Range (HDR) images

In a photo realistic HDR image, each pixel corresponds to a realistic luminance value.

For creating a luminance based HDR image we need:

- Tripod (to take photos with different exposure values)
- Manual Settings in Digital Cameras
- Fix aperturer (usually F8 or F11)
- Fix ISO: (usually 100)

- Fix white balance (usually daylight)
- Switch off other post processing functions

Or use RAW files instead of JPEGs

High Dynamic Range (HDR) images

In a photo realistic HDR image, each pixel corresponds to a realistic luminance value.

Advantages, Disadvantages and Errors:

When taking HDR photos with DSLR cameras:

Probable errors:

- Image mis-alignment due to movement of camera
- Changes in direction and/or level of (natural) light during capturing process
- Lens vignetting effects
- Lens flare effects
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Some advantages:

- The possibility to use different lenses (such as a variety of fisheye lenses, etc.)
- In case of using a full frame sensor DSLR cameras with higher resolution the quality and accuracy can be higher.

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Some disadvantages:

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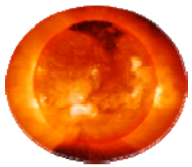
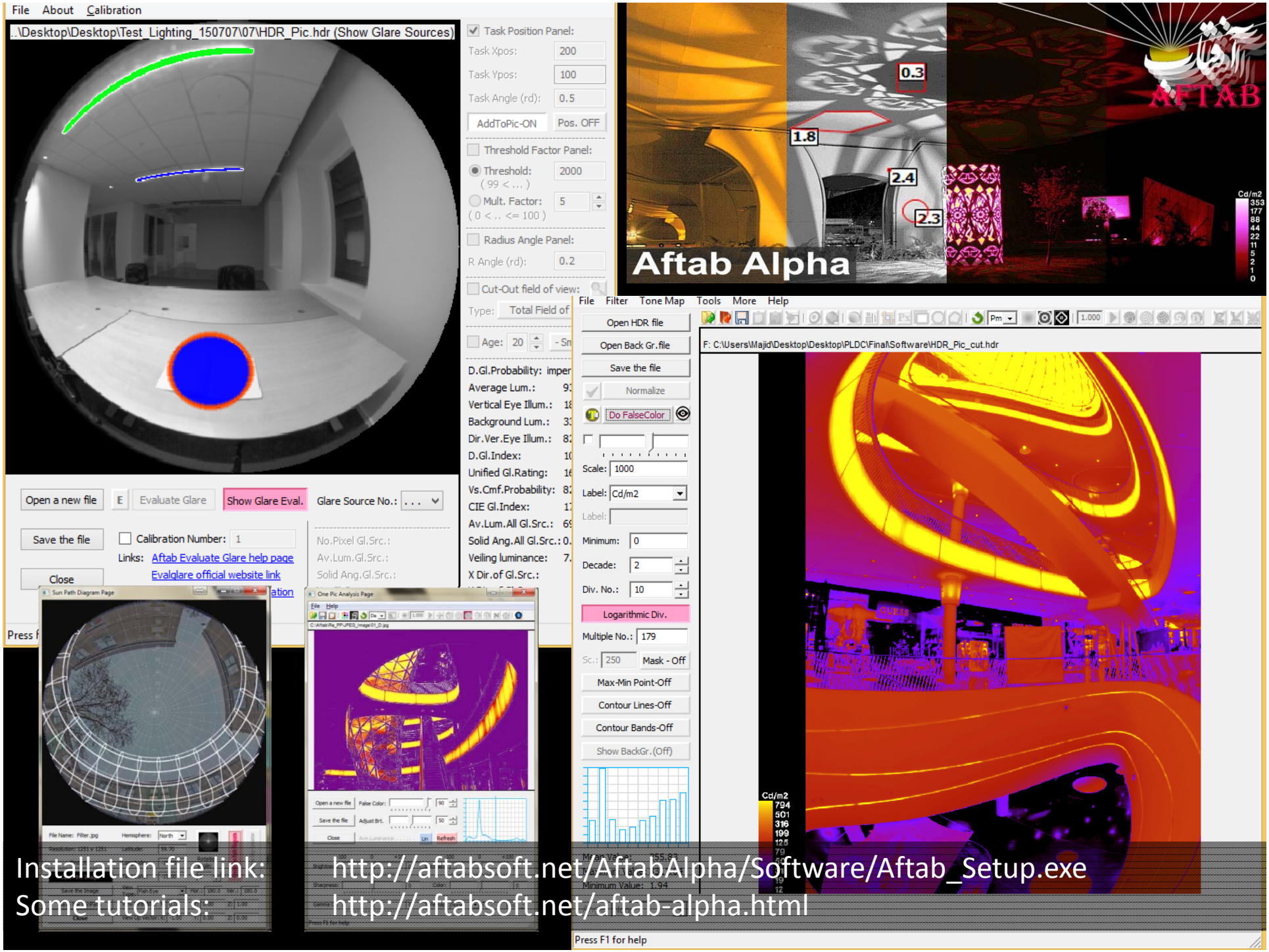
-> So it is not fast to read the lumiance values right after taking photos



Photosphere WebHDR

wxfalsecolor hdrscope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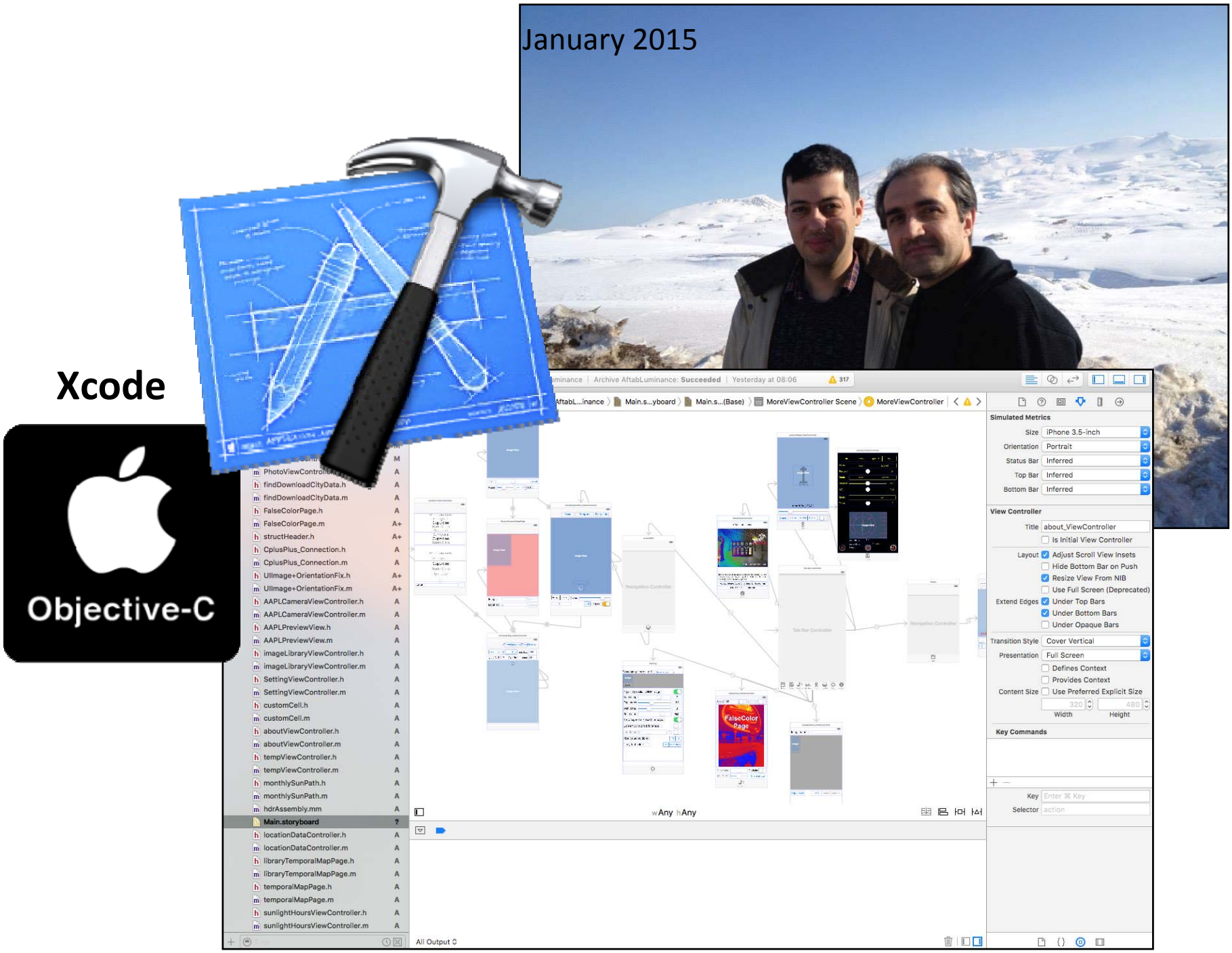
Task Xpos: 200
Task Ypos: 100
Task Angle (rd): 0.5
AddToPic-ON
Pos. OFF
Threshold Factor Panel:
Threshold: 2000
(99 < ,,,)
Mult. Factor: 5
(0 < ,, <= 100)
Radius Angle Panel:
R Angle (rd): 0.2
Cut-Out field of view:
Type: Total Field of
Age: 20
D.Gl.Probability: imper
Average Lum.:
Vertical Eye Illum.:
Background Lum.:
Dir.Ver.Eye Illum.:
D.Gl.Index:
Unified Gl.Rating:
Vs.Cmf.Probability:
CIE Gl.Index:
Av.Lum.All Gl.Src.:
Solid Ang.All Gl.Src.:
Veiling luminance:
X Dir.of Gl.Src.:
Open a new file
E
Evaluate Glare
Show Glare Eval.
Glare Source No.:
Save the file
Calibration Number: 1
Links: Aftab Evaluate Glare help page
Evalglare official website link
Close
No.Pixel Gl.Src.:
Av.Lum.Gl.Src.:
Solid Ang.Gl.Src.:
Press f
0.3
1.8
2.4
2.3
Cd/m2
353
177
88
44
22
11
5
2
1
0
Aftab Alpha
AFTAB
File Filter Tone Map Tools More Help
Open HDR file
Open Back Gr.file
Save the file
Normalize
Do FalseColor
Scale: 1000
Label: Cd/m2
Label:
Minimum: 0
Decade: 2
Div. No.: 10
Logarithmic Div.
Multiple No.: 179
Sc.: 250
Mask - Off
Max-Min Point-Off
Contour Lines-Off
Contour Bands-Off
Show BackGr.(Off)
F: C:\Users\Majid\Desktop\Desktop\PLDC\Final\Software\HDR_Pic_cut.hdr
Cd/m2
794
501
316
199
125
79
Press F1 for help
Installation file link: http://aftabsoft.net/AftabAlpha/Software/Aftab_Setup.exe
Some tutorials: http://aftabsoft.net/aftab-alpha.html


January 2015
Xcode
Objective-C

What is available in our smartphones?

- Accelerometers / gyroscope sensors
- GPS sensors
- Camera
- Touchscreen

- Good CPU and Memory

All in one device

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- Accelerometers / gyroscope sensor
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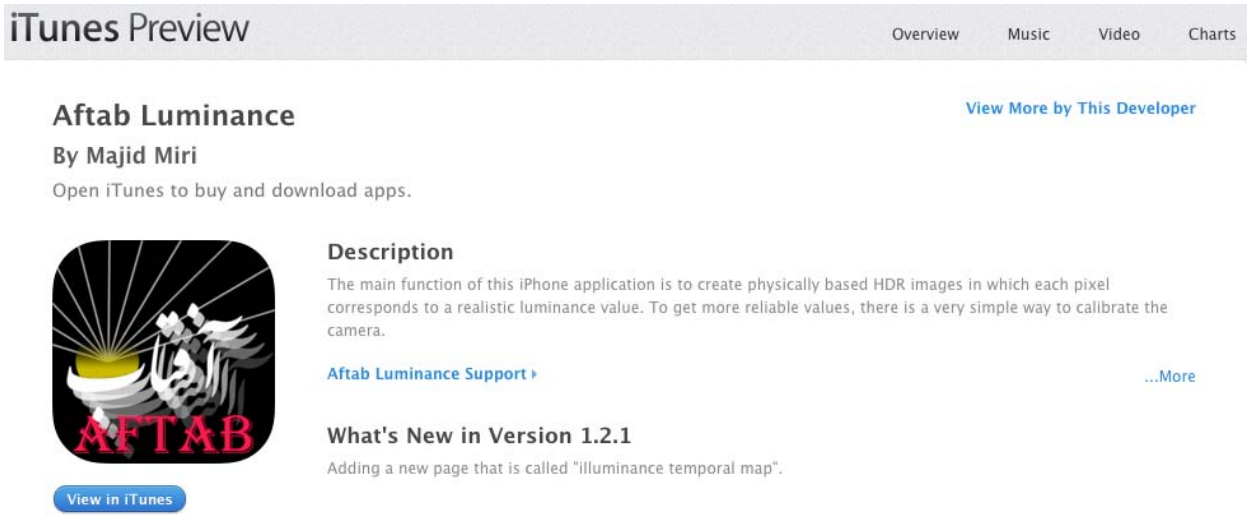
All in one device
and
It is usually with us

What is available in the Aftab Luminance iPhones app?

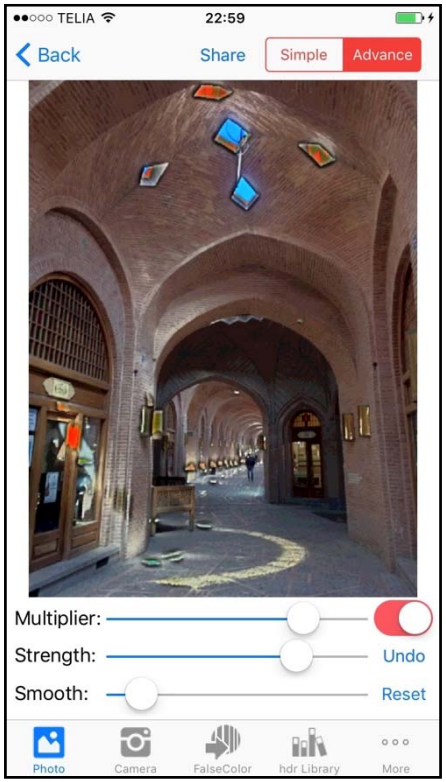
- Aperture is fixed to ≈ 2.2 – 2.4
- Manual exposure settings (from IOS 8 and later version)
  - ISO: 32 - 1600
  - Shutter Speed: (nominally) 1/2 – 1/50,000 ???
  - White Balance
- Bracketing
  - 3 or 4 images (based on the model)
- Maximum Exposure step is 3.00

So now, it is possible to have a **Physically Based HDR Assembly App**

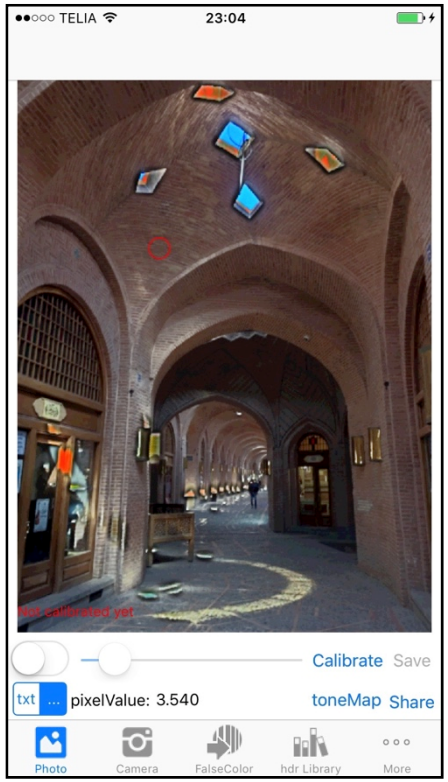


https://itunes.apple.com/us/app/aftab-luminance/id1054568119?mt=8

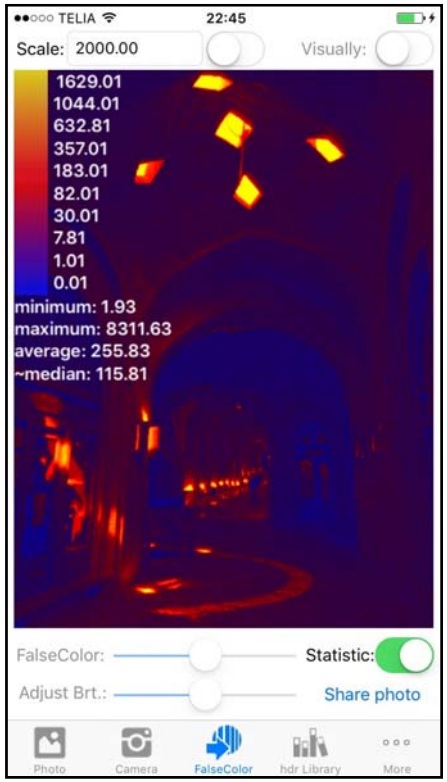
What is available in the Aftab Luminance iPhones app?



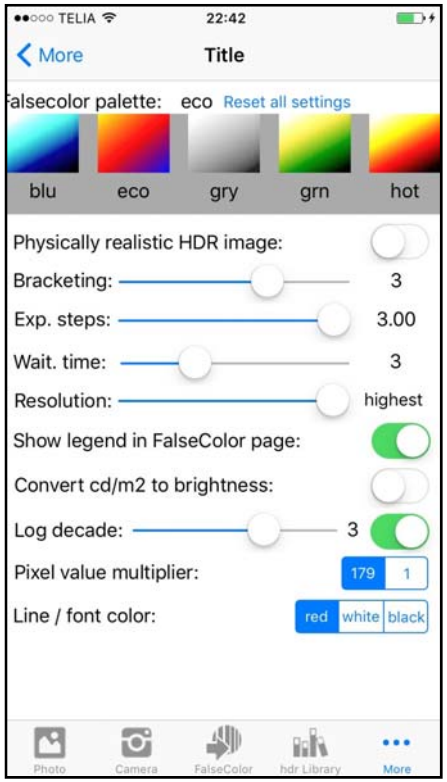
- Simple tone-mapping



- Reading the pixel or circular area in cd/m^2



- Creating linear or logarithmic falsecolor images



What is available in the Aftab Luminance iPhones app?

By enabling this switch, the ISO and white balance are fixed, and the other post processing functions are switched off too

The number of bracketing shots

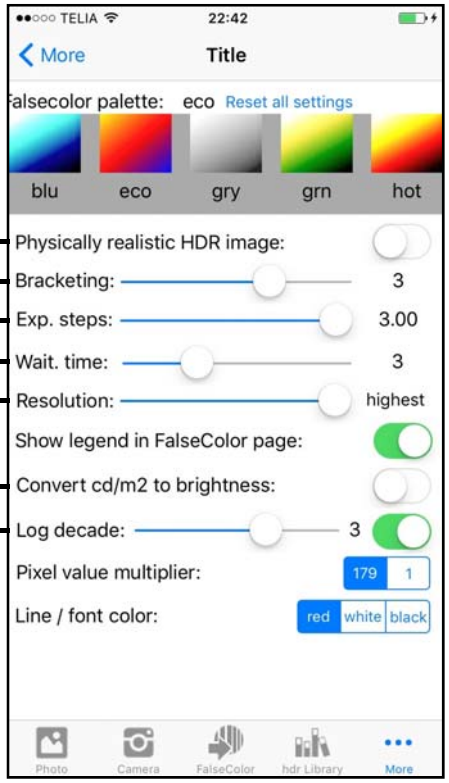
Exposure compensation in Automatic Exposure Bracketing

The self timer for a delayed camera shutter

Change the image resolution between the lowest and highest

Change all values from luminance to brightness based on the luminance-brightness power relationship based on an exponent of 1/3 (DiLaura, Houser, Mistrick, et. al. 2011, p. 4.10)

The number of decades in logarithmic mapping of falsecolor images



What is available in the Aftab Luminance iPhones app?

By drag and drop the HDR files, we can save the HDR files in the phone or the computer via iTunes

What is available in the Aftab Luminance iPhones app?

Advantages, Disadvantages and Errors:

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Some advantages:

- No needs to have a external computer software (like Photosphere, Aftab, etc.) to assemble LDR photos and create an HDR image ->
-> So it is easy to read the lumiance values right after taking photos

Some disadvantages:

- The possibility of using different lenses (such as a variety of fisheye lenses, etc.) is low.

- The quality and accuracy of smart phone camera images sensors is less than DSLR cameras.

What is available in the Aftab Luminance iPhones app?

Applications of luminance based HDR photos?

- Rules and recommendations

- Measuring the minimum acceptable and preferable background luminance (surrounding walls and ceilings) for the offices (30 cd/m2 for the former and between 60 cd/m2 and 100 cd/m2 for the latter *)
- Measuring the following luminance ratios for offices*:
  - Between a paper task and an adjacent Visual Display Terminal (VDT) screen: 3:1 or 1:3.
  - Between a task and immediately adjacent surroundings: 3:1 or 1:3.
  - Between a task and remote (non-adjacent) surfaces: 10:1 or 1:10.
- Measuring the access zone luminance (L20) **
- Measuring obtrusive light permitted for exterior lighting installation ***
- Measuring average road luminance and longitudinal uniformity of road surface luminance ****

* Recommended Practice for Office Lighting, Illuminating Engineering Society of North America, 2012
** The guide for the lighting of road tunnels and underpasses CIE 88:2004
*** The European standard of EN-12464-2 or CIE 150:2003
**** The road lighting European standard of EN-13201

Applications of luminance based HDR photos?

- Finding the glass visible light transmission, etc.

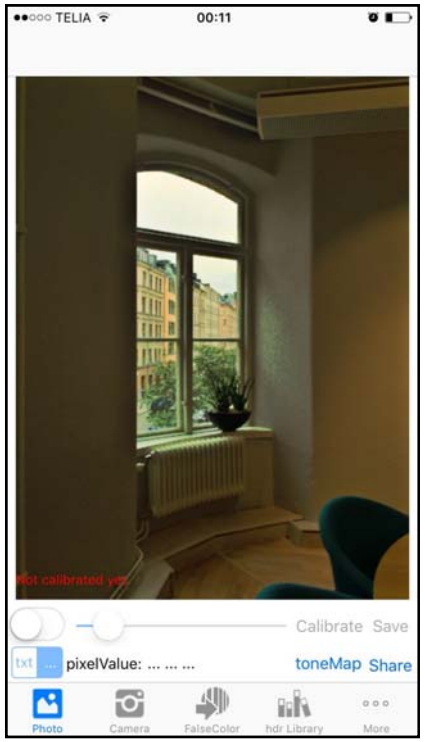
- Since **brightness** and **luminance** correspond **with each other** and, as we know, **what we see** is more **relevant to brightness** rather than **LUX** level, performing luminance-based light analysis can be much more helpful in order to **understand the lighting conditions** of the space in question.
- Considering **recently developed physically based lighting calculation tools** and **HDR assembly software**, and their ability to analyze visibility, appearance and visual comfort of any space, **lighting designers**, **researchers**, **manufactures**, **codes and standard organizations**, etc. can apply luminance based metrics much more than ever before.

What is available in the Aftab Luminance iPhones app?

- Accelerometers / gyroscope sensor
- GPS sensors
- Camera
- Touchscreen

- Good CPU and Memory

- Latitude
- Longitude
- Time Zone
- Camera View Point
- Camera View Direction
- Camera View Up Vector



20160714164554.hdr

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#VerSensorSize=3.670
#latitude=59.33
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The header of the HDR File that is created by Aftab Luminance iPhone App

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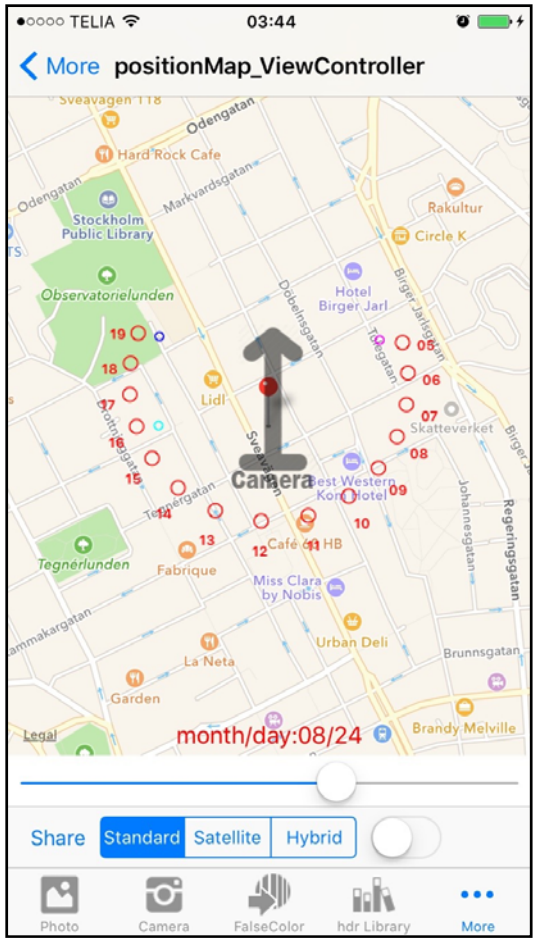

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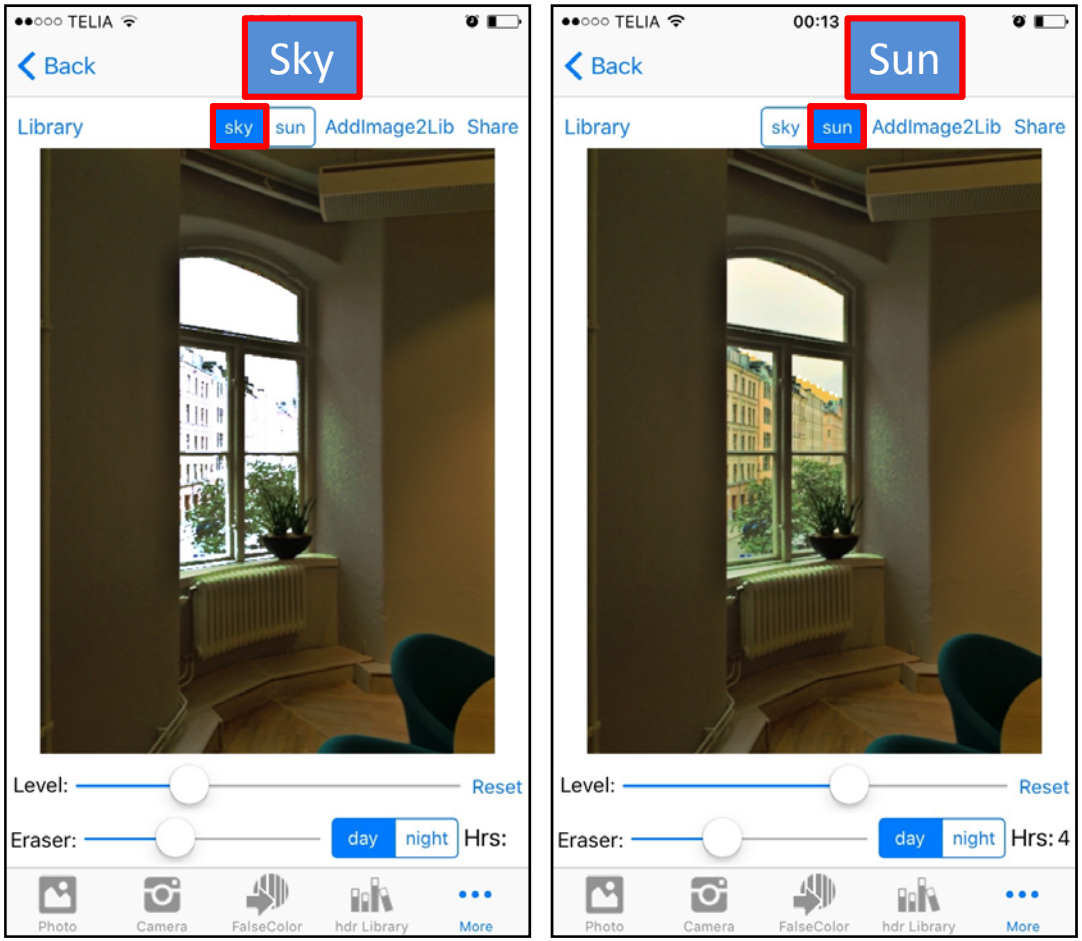

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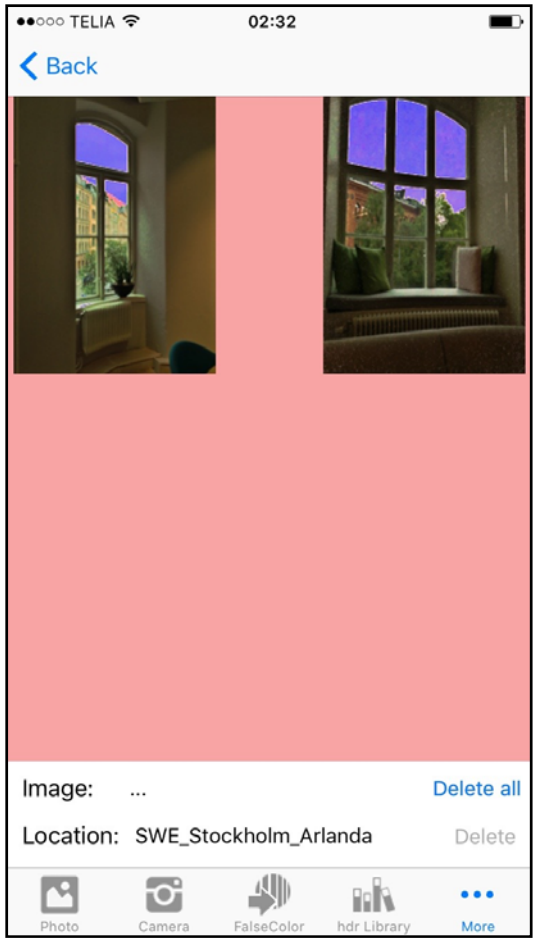

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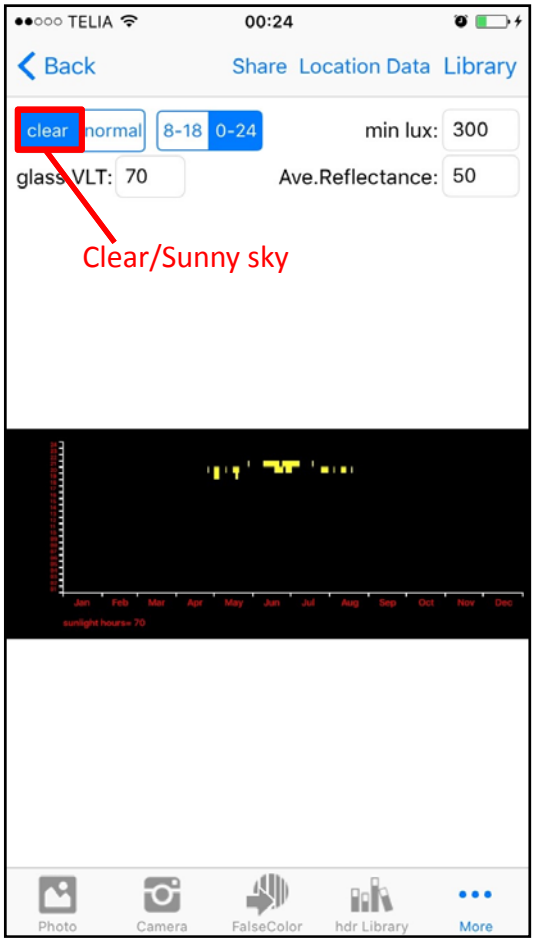

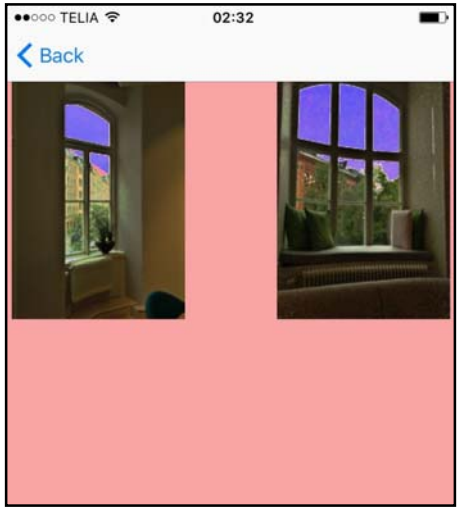

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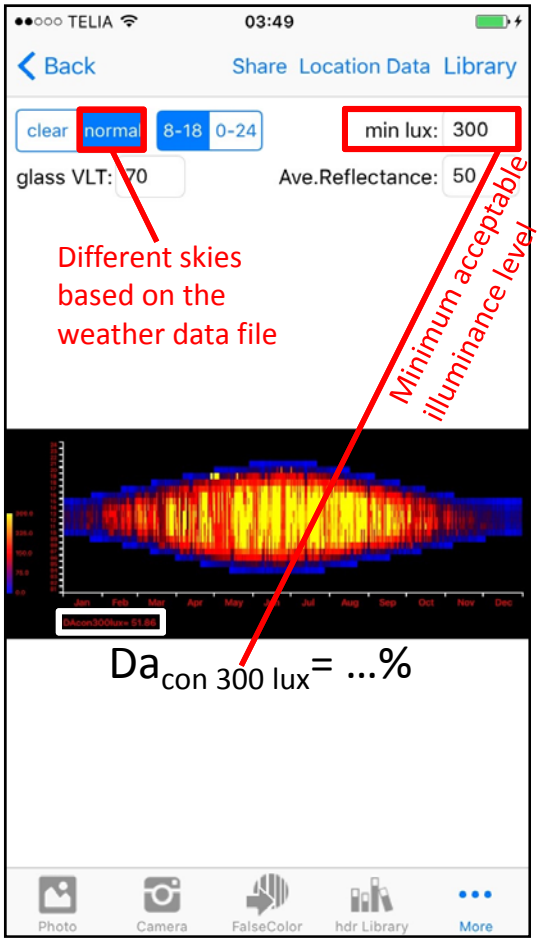

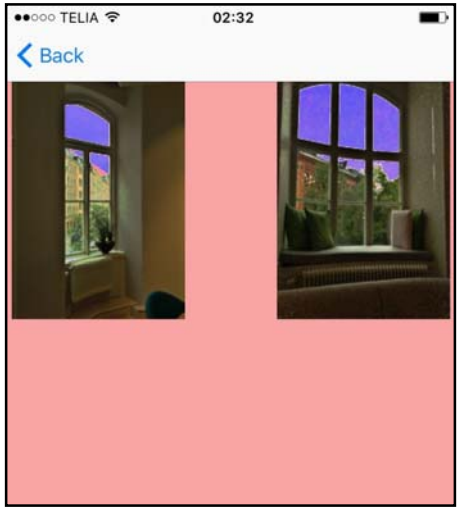

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+

Average Reflectance of Interior Space

+

Glass Visible Light Transmission Value

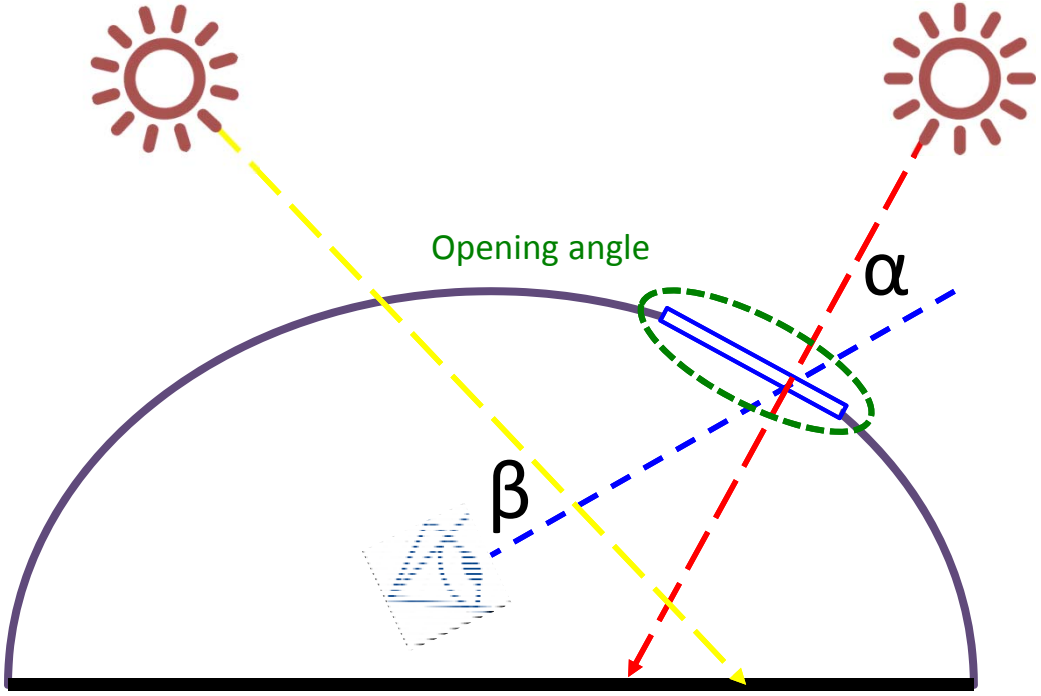
+

The angle between sun rays and view directions

+

-Direct Normal Illuminance
-Diffuse Horizontal Illuminance
-Global Horizontal Illuminance

The simple formula to estimate the horizontal lux on the camera point



$$
\begin{aligned}
Lux = (\,&\big(Direct\ Normal\ Illuminance \times \cos \propto \times (openings\ angle_{sky} + openings\ angle_{obs})\big) \\
&+ \big(Diffuse\ Horizontal\ Illuminance \times openings\ angle_{sky}\big) \\
&+ ((Diffuse\ Horizontal\ Illuminance \\
&+ (Direct\ Normal\ Illuminance \times \cos\beta)) \times Reflection_{obs} \times openings\ angle_{obs})\,) \\
&\times \frac{GVLT}{(1-\rho)\times 180 \times 360}
\end{aligned}
$$

Maximum of **Opening Angle** is 360 x 180

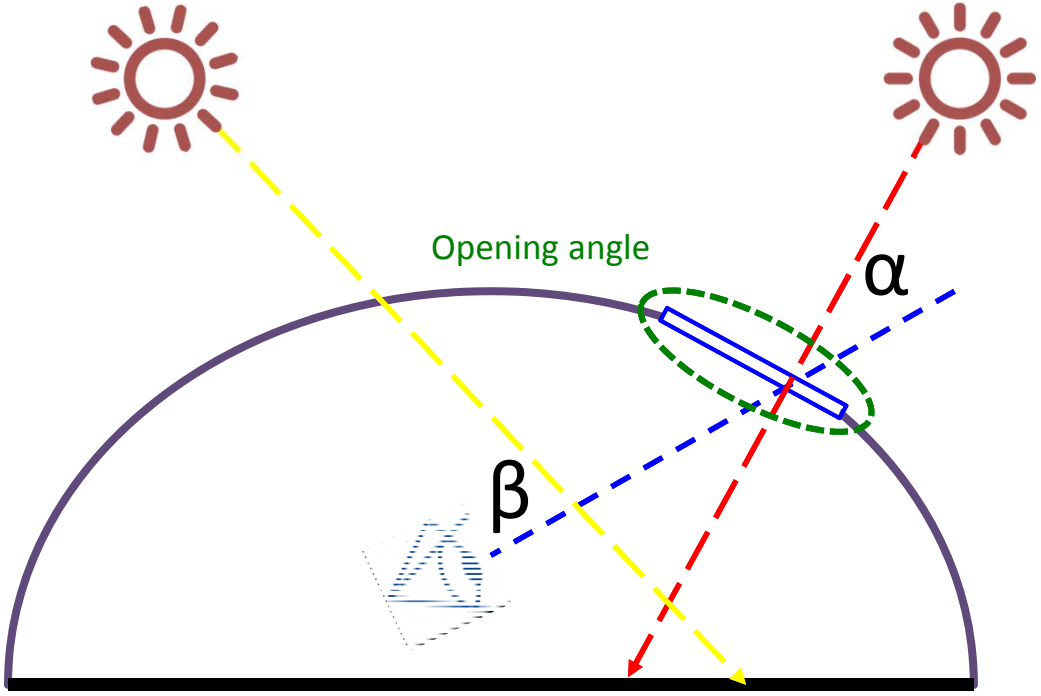
ρ = Average material reflection of interior elements

α = The angle between the view direction and sun rays

GVLT = Glass Visible Light Transmission

β = The angle between the view direction and sun rays

The simple formula to estimate the horizontal lux on the camera point



$$\text{Lux} = \frac{(Direct\ Normal\ Illuminance \times \cos \propto) + Diffuse\ Horizontal\ Illuminance}{(1-\rho)} \times \frac{openings\ angle}{180 \times 360} \times GVLT$$

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ρ = Average material reflection of interior elements

α = The angle between the view direction and sun rays

GVLT = Glass Visible Light Transmission

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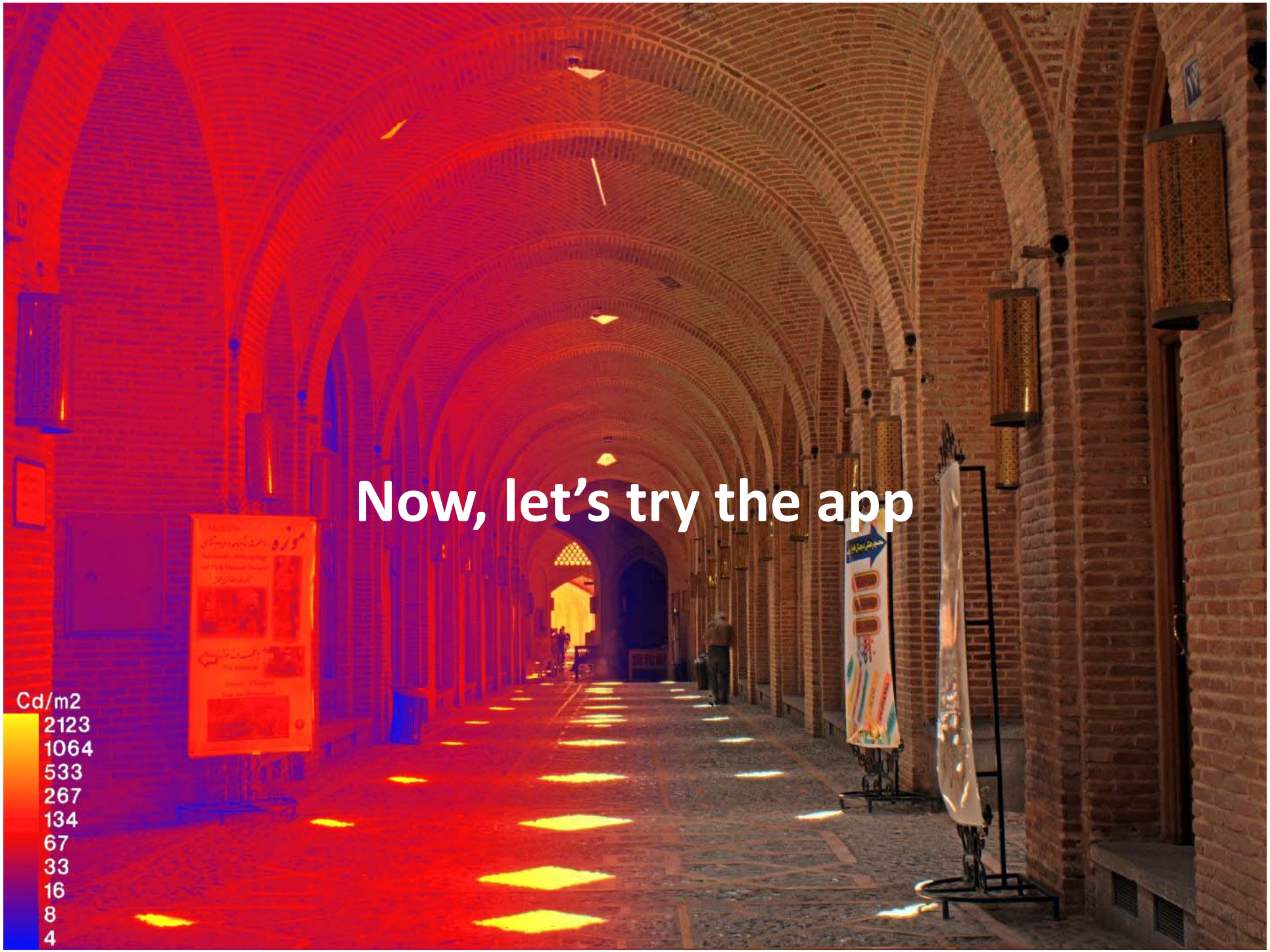
Applications of sunpath/temporal mapping pages?

- Estimating Sunlight Hours for the camera points
- Estimating available illuminance value on the camera point for the whole year by creating a temporal mapping falsecolor image
- Estimating Continous Daylight Autonomy on the camera point

- Defining the camera point as daylit, partially daylit or non daylit point
- Check the changes in illuminance availability when playing with varying in glass tranmission, reflectancy and size of windows


Now, let’s try the app
Cd/m2
2123
1064
533
267
134
67
33
16
8
4