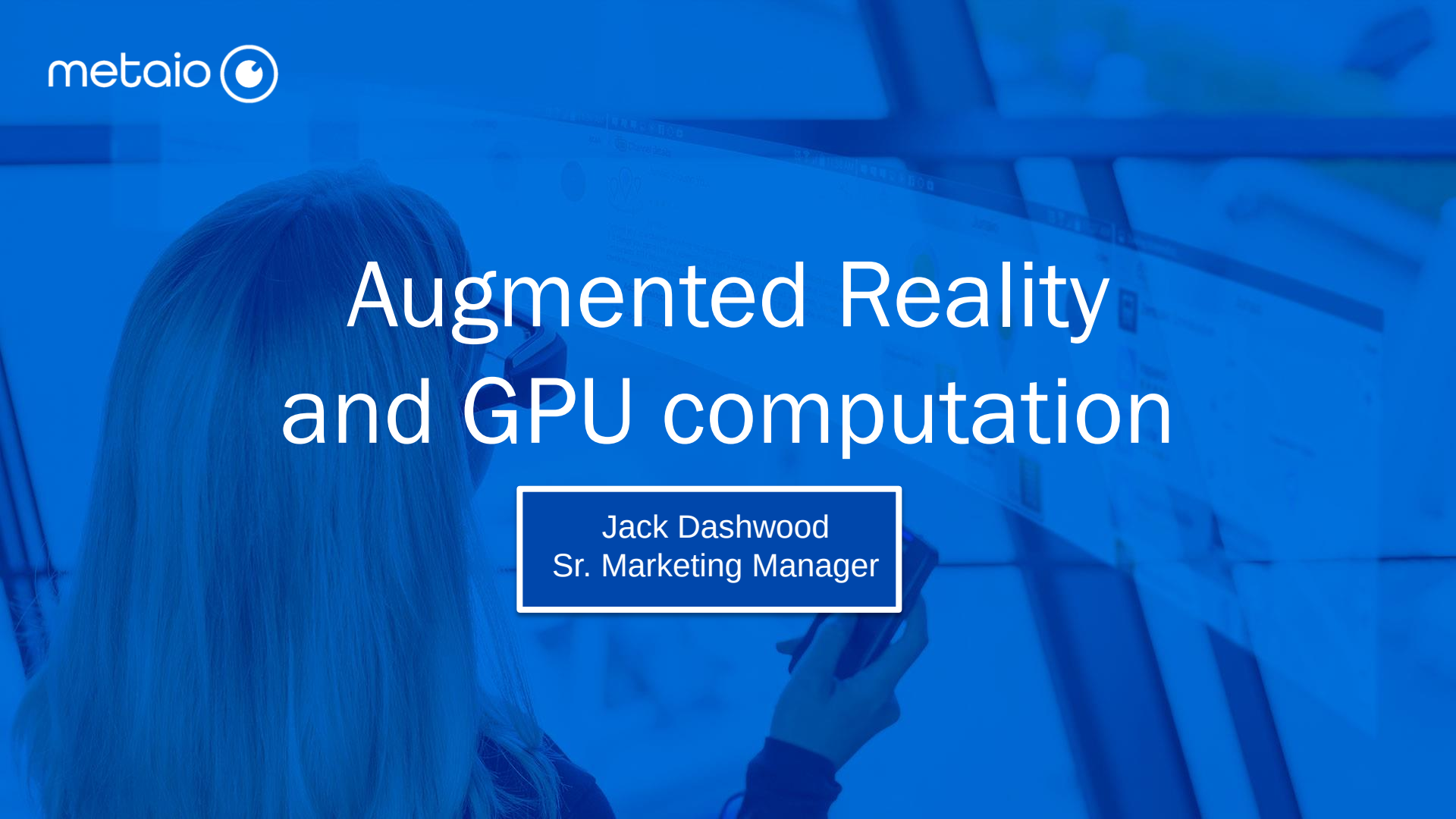


Augmented Reality and GPU computation

Jack Dashwood
Sr. Marketing Manager

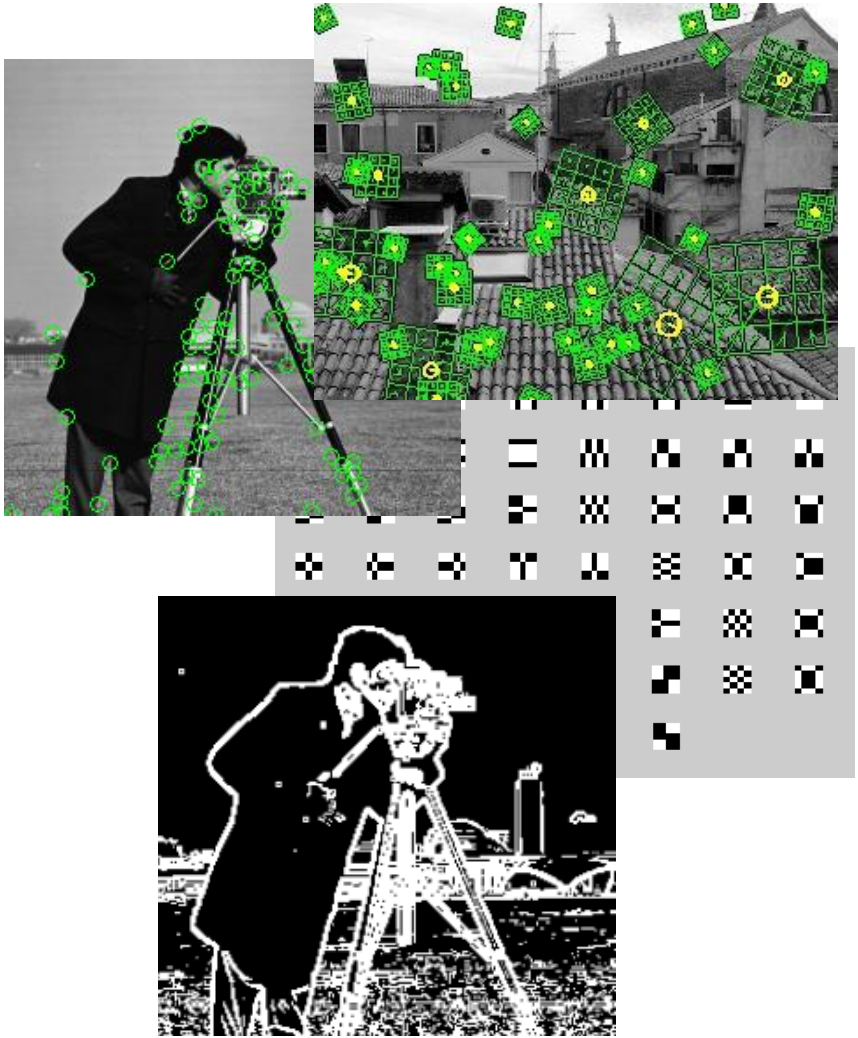
Agenda

- What is Augmented Reality (AR)
- Why is AR computationally expensive and how can GPU help
- Future of AR (with the help of GPU)

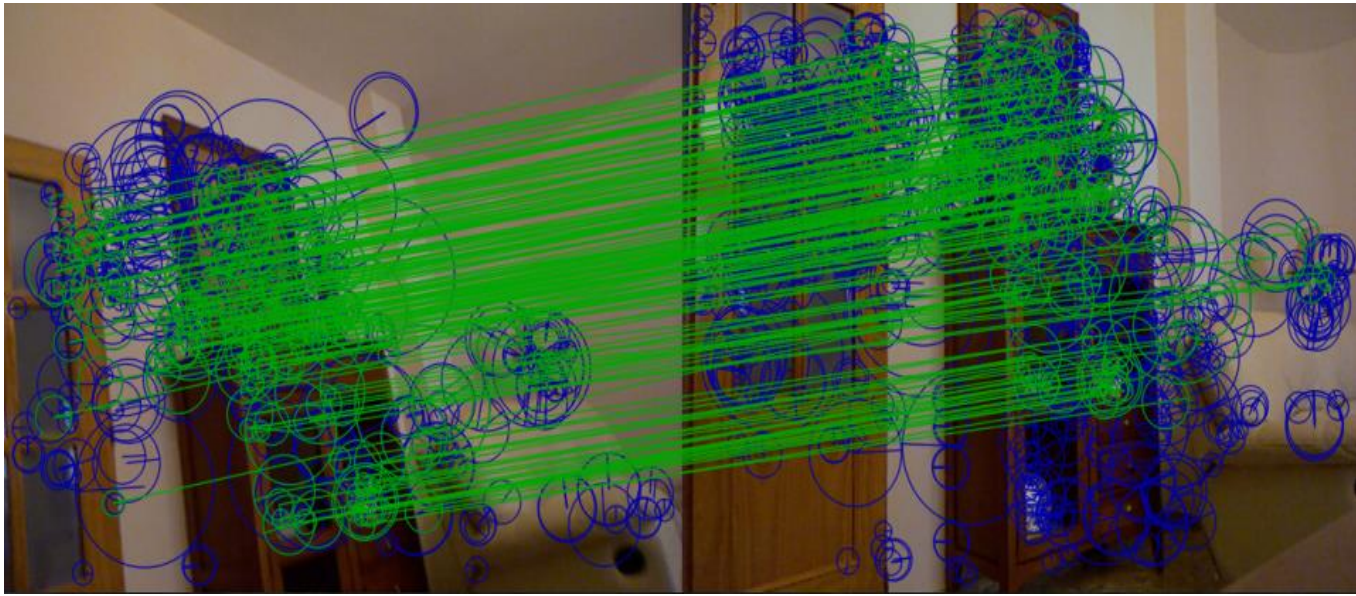
What is Augmented Reality

Why is AR computationally expensive and how can GPU help

- The key for AR is understanding “our reality”: recognize and understand the space.
- Features (detection, description, matching, tracking) play a key role
  - SIFT
  - SURF
  - Corners
  - Edges
  - Etc…



Example: 2D feature matching

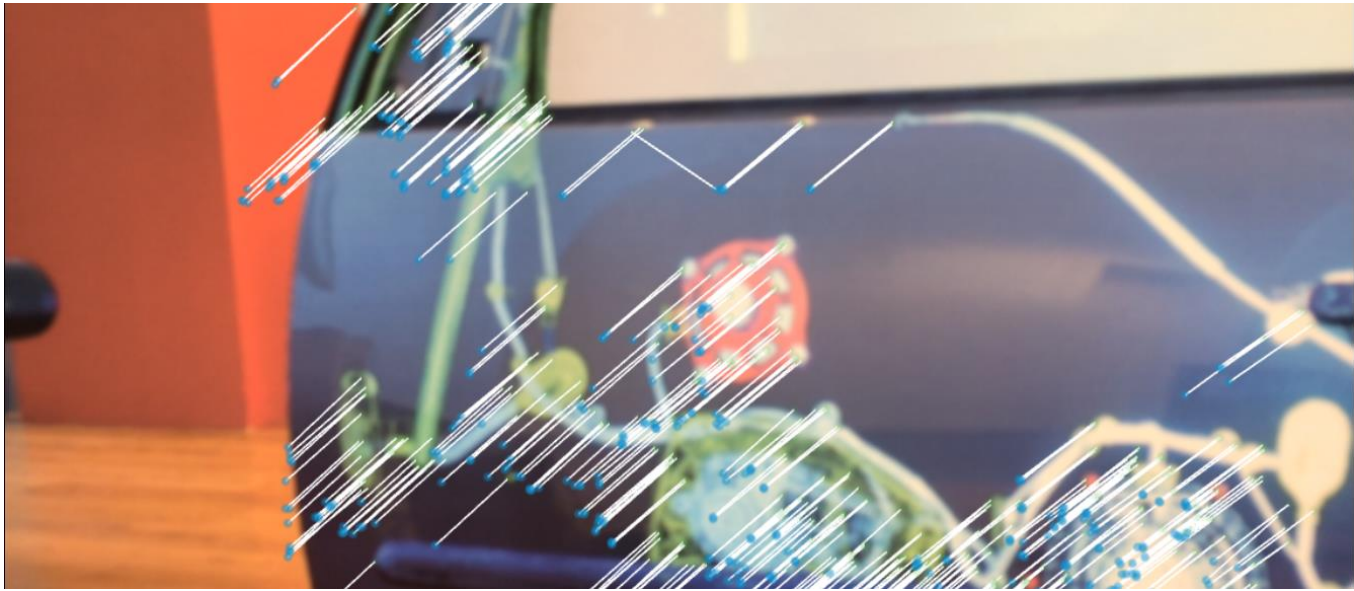


http://thecomputervision.blogspot.de

- In a 10k features case, matching takes around 80% of the time (around 41.7 ms) on a PC (CPU speed 2.4 GHz) ➔ roughly 20 FPS.

- A seamless AR experience should reach at least 30 FPS (more in case of VR).

Example: 2D feature tracking



- In a 10k features case, tracking takes **around 35**%

- Typically we want to do both matching and tracking in the same frame (extract new features, match them *and* track those that were observed earlier).

Hybrid Model Tracking

Hybrid Edge / SLAM Tracking with (GP)GPU support

Some numbers

Iterations * Samples, Number of Lines	15 x 100, 40	15 x 200, 40	15 x 1000, 50	15 x 5000, 5000	15 x 5000, 10000
Car Model	**No**	**No**	**Manually built small car model**	**Complex Generated car model**	**Very Complex generated car model**
Original implementation	30ms (33fps)	64ms (16 fps)	180ms (5.5fps)	440ms (2 fps)	920ms (1fps)
Optimized version for CPU	30ms (33fps)	61ms (16 fps)	140ms (7 fps)	270ms (4 fps)	310ms (3.5fps)
Optimized version for GPGPU	40ms (25 fps)	40ms (25 fps)	42ms (24 fps)	44ms (23 fps)	(47ms) (21 fps)

Green: real-time capable, Orange: shaky, Red: too slow

Future of AR (with the help of GPU)

RGB-D Sensors at Metaio

Kinect/Asus/PrimeSense

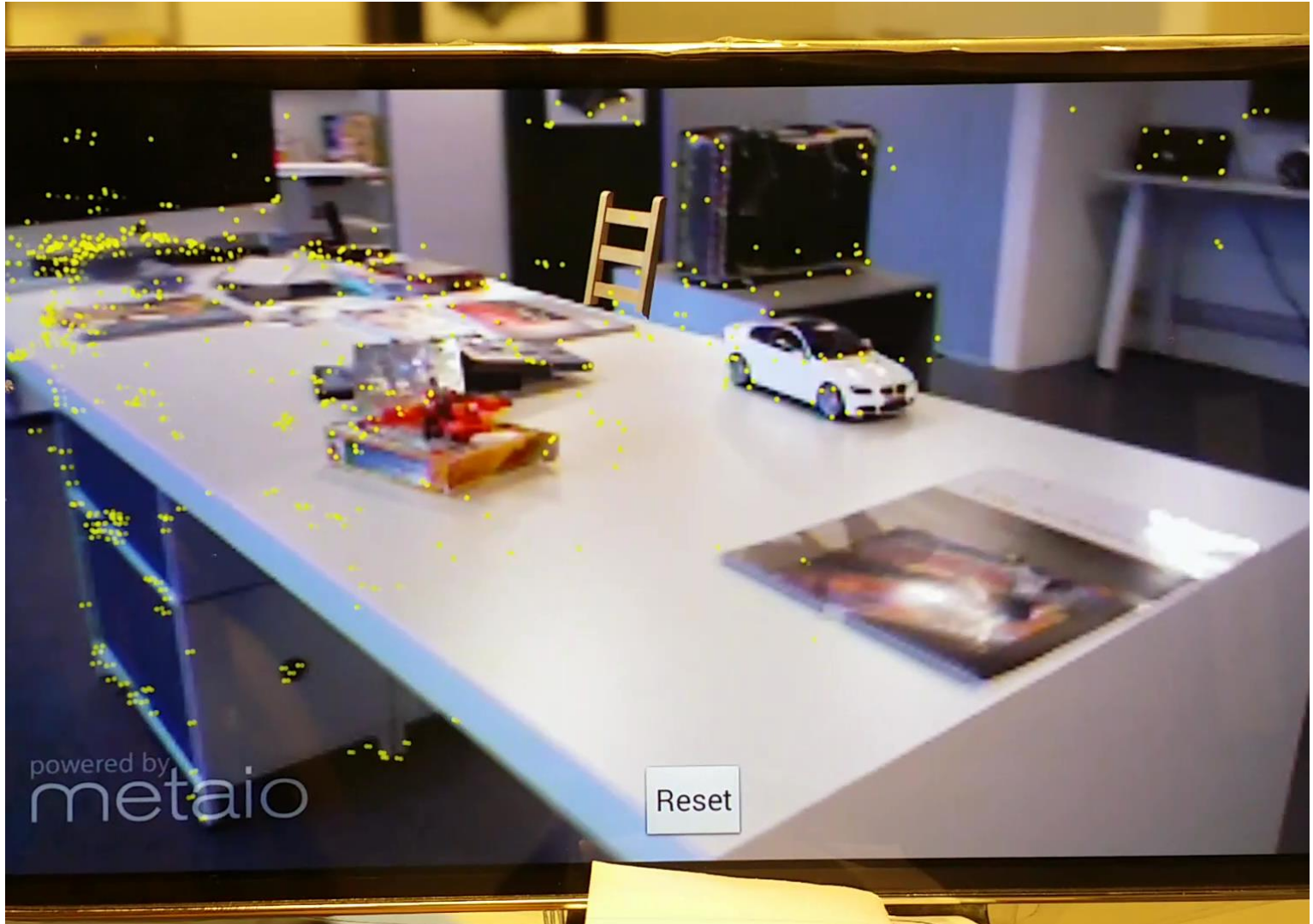
Kinect One

Occipital/Structure Sensor

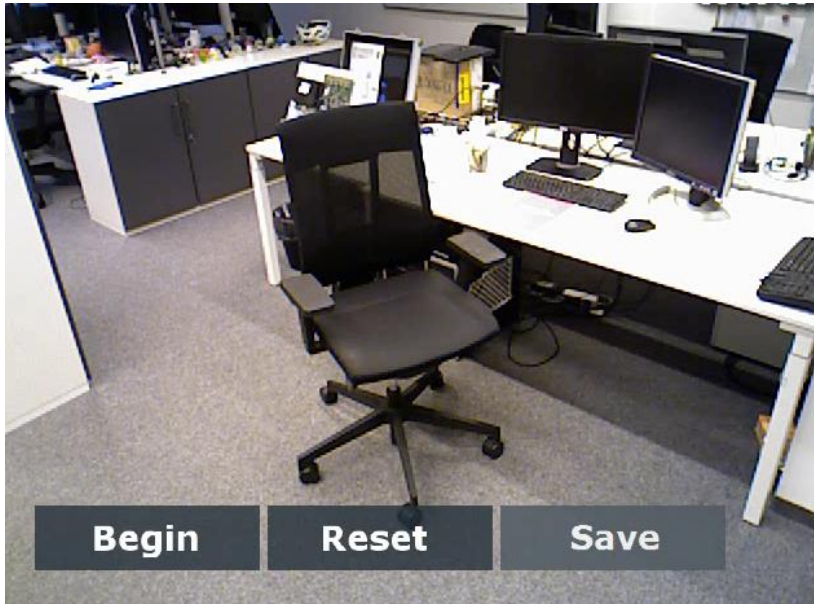
Creative Cam

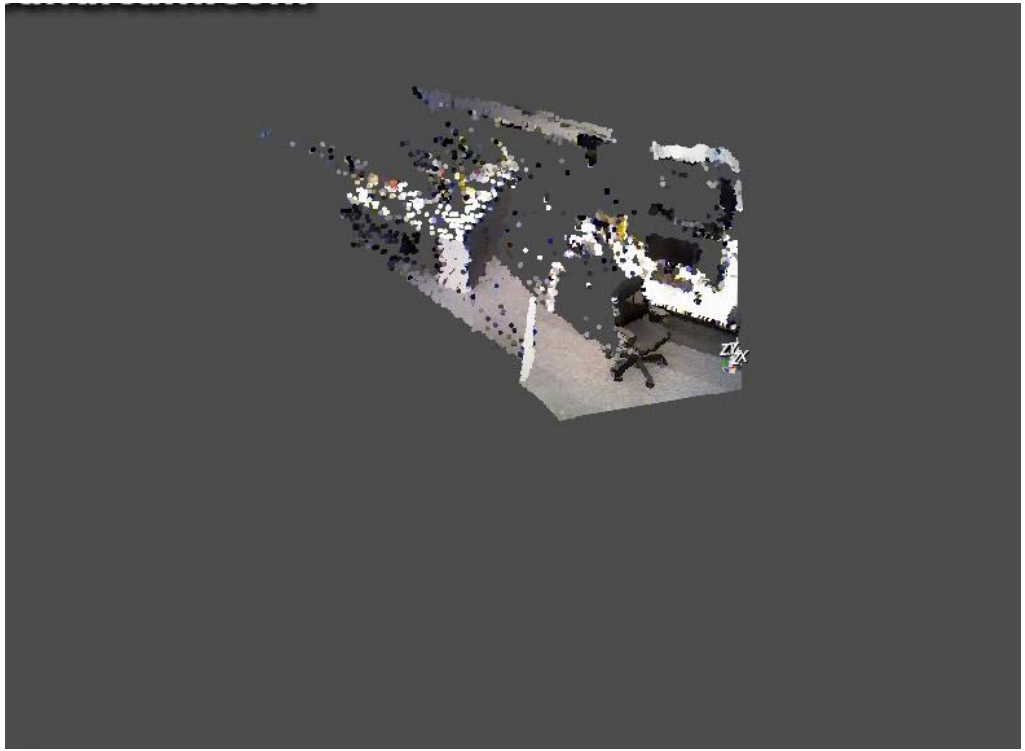
Tango Phone/Tablet

others

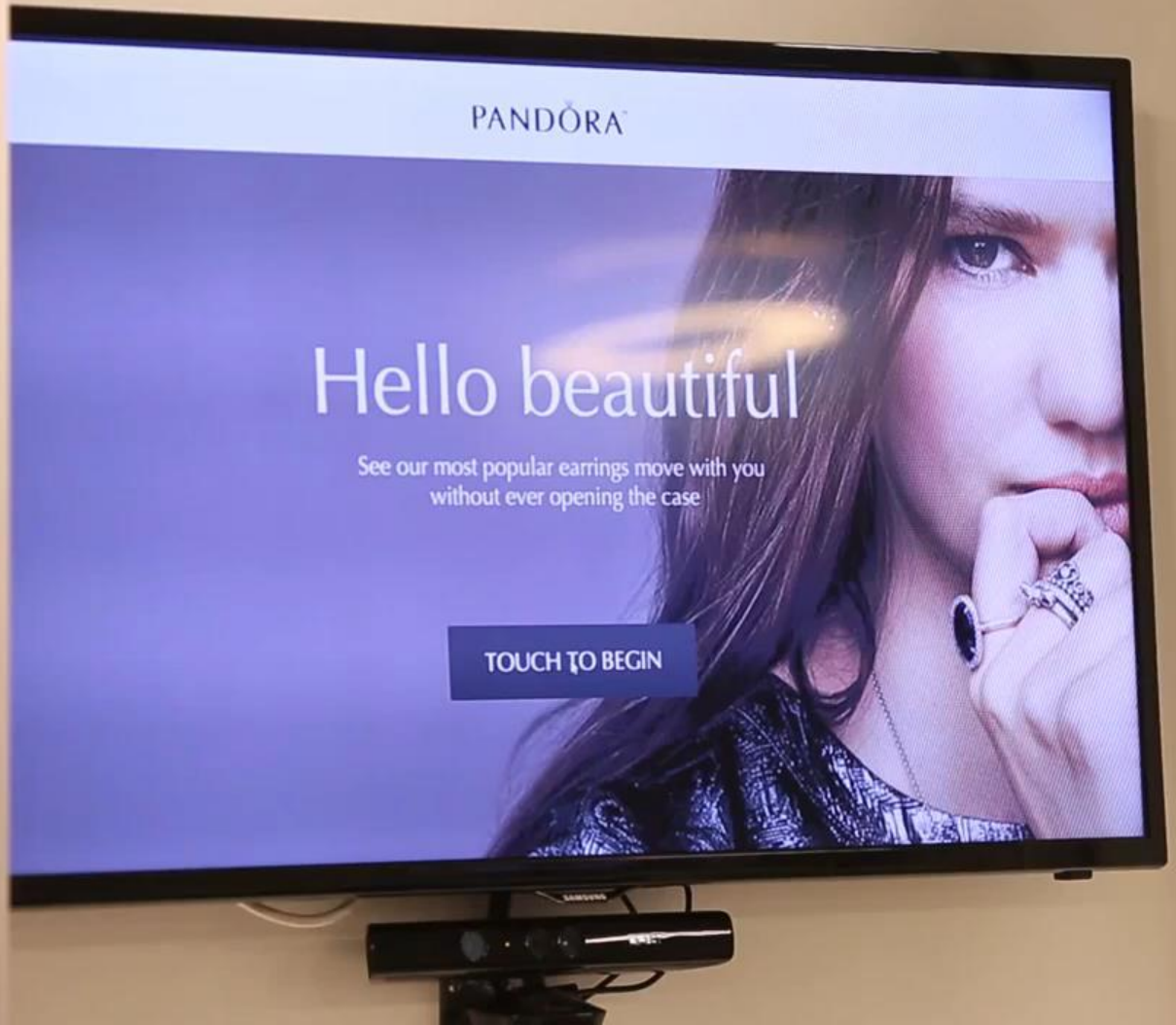

powered by
metaio
Reset

Dense Visual Odometry

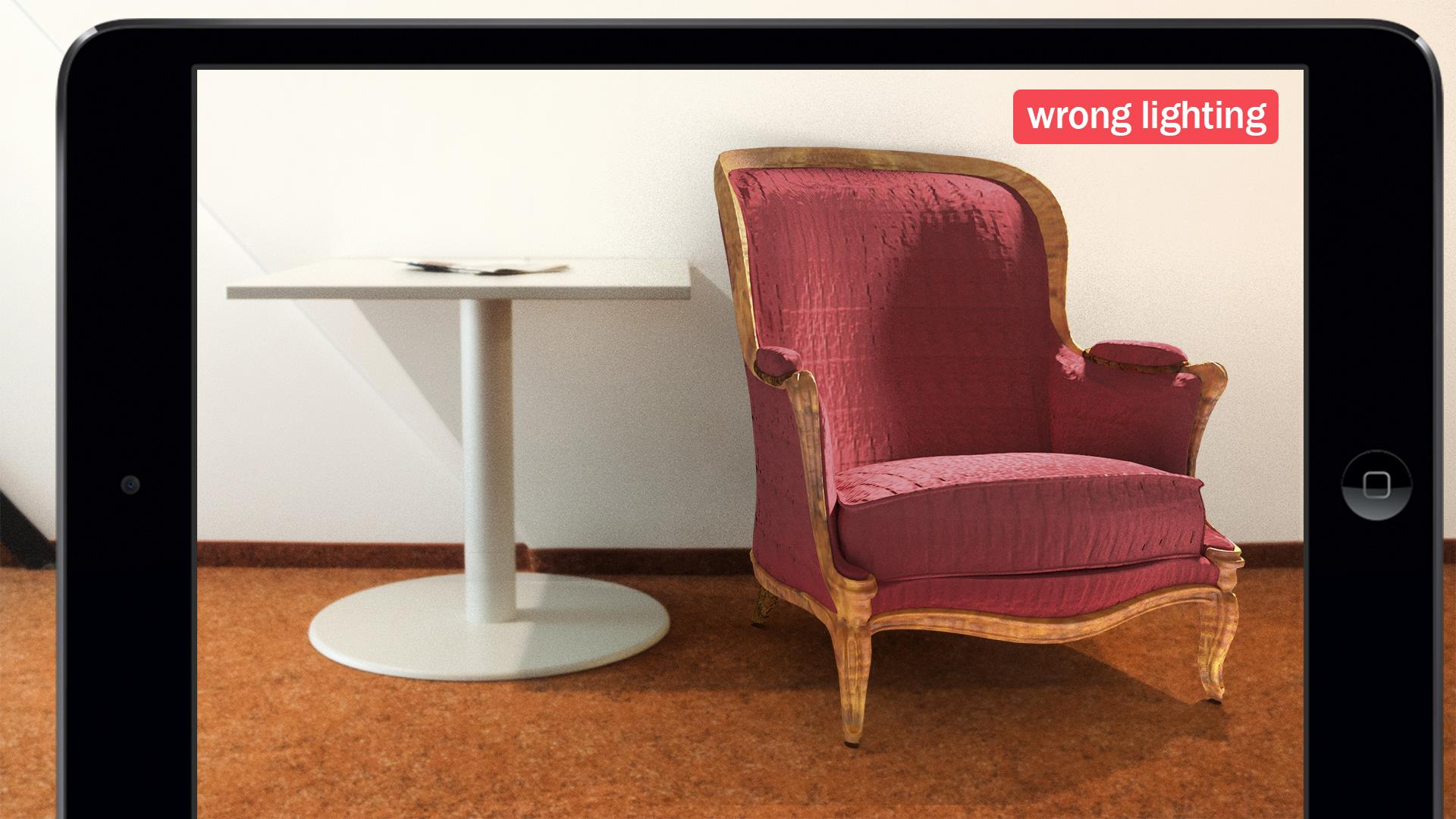


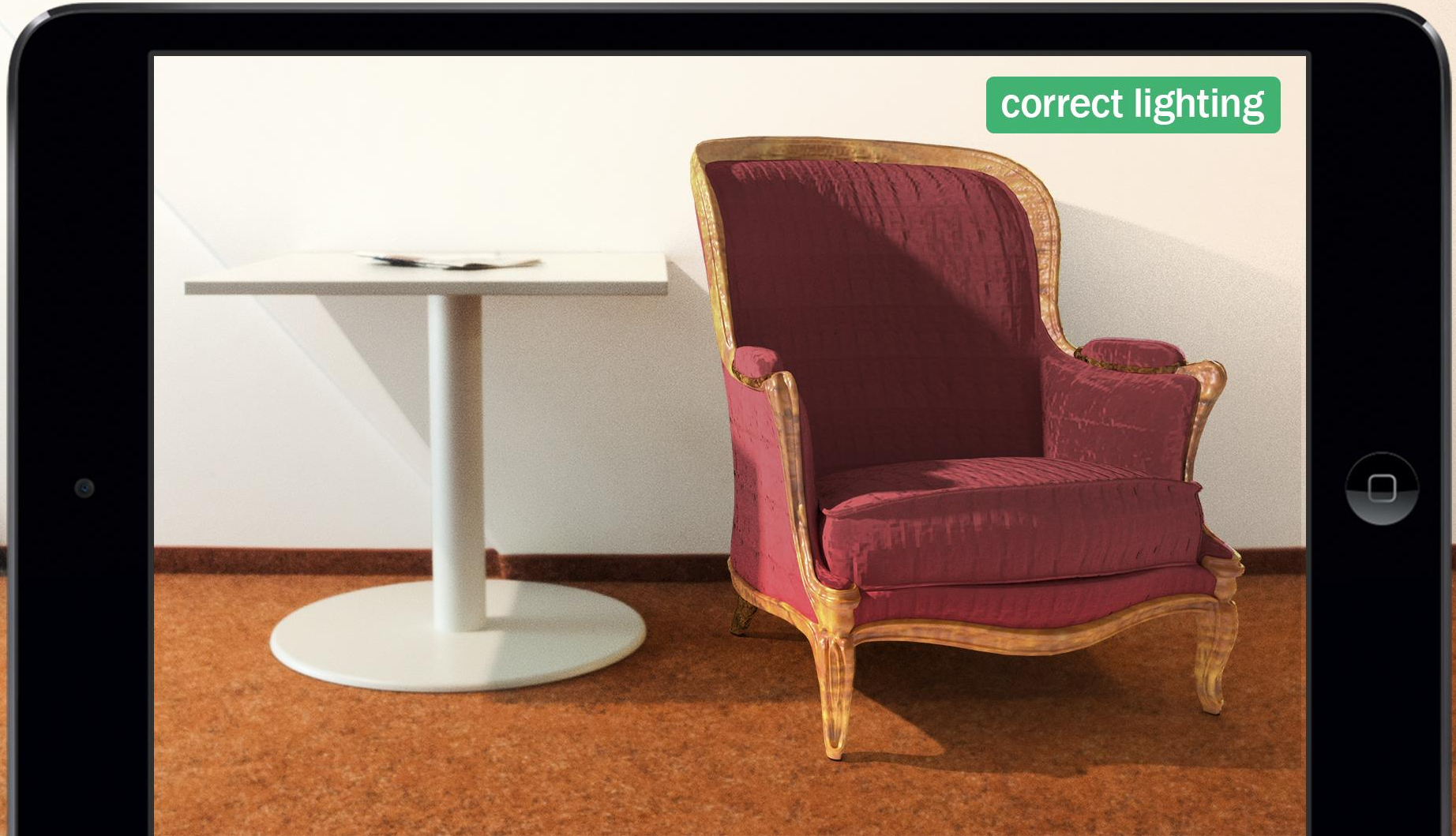



lenovo
metaioSDK
ys on, always augmented
Demos


PANDORA
Hello beautiful
See our most popular earrings move with you
without ever opening the case
TOUCH TO BEGIN


Coherent Illumination
in Augmented Reality


wrong lighting


correct lighting







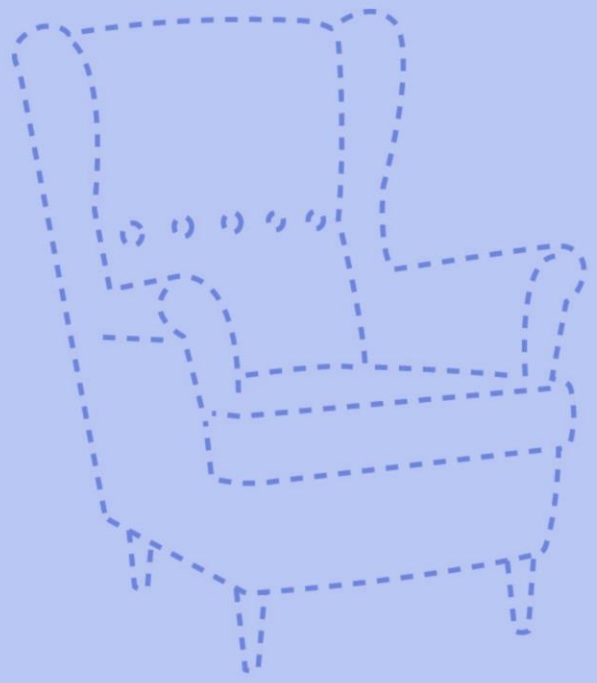

USING THE USER'S HEAD AS A LIGHT PROBE

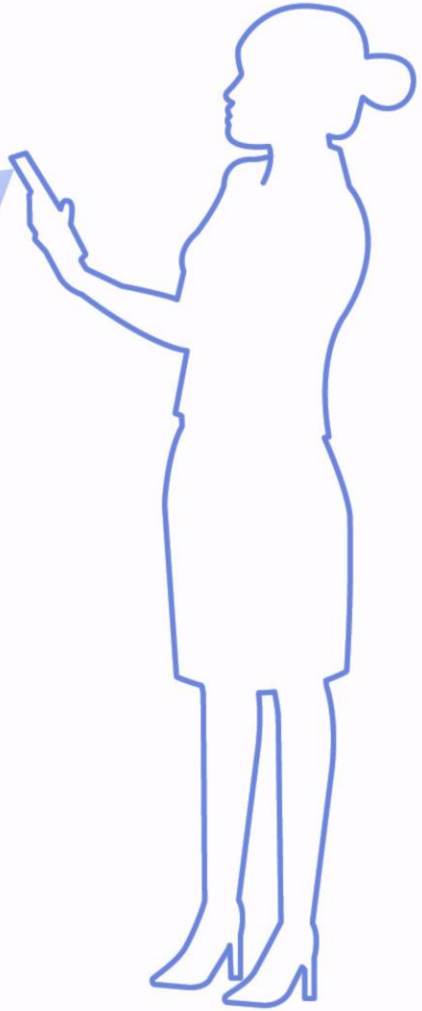
MACHINE LEARNING

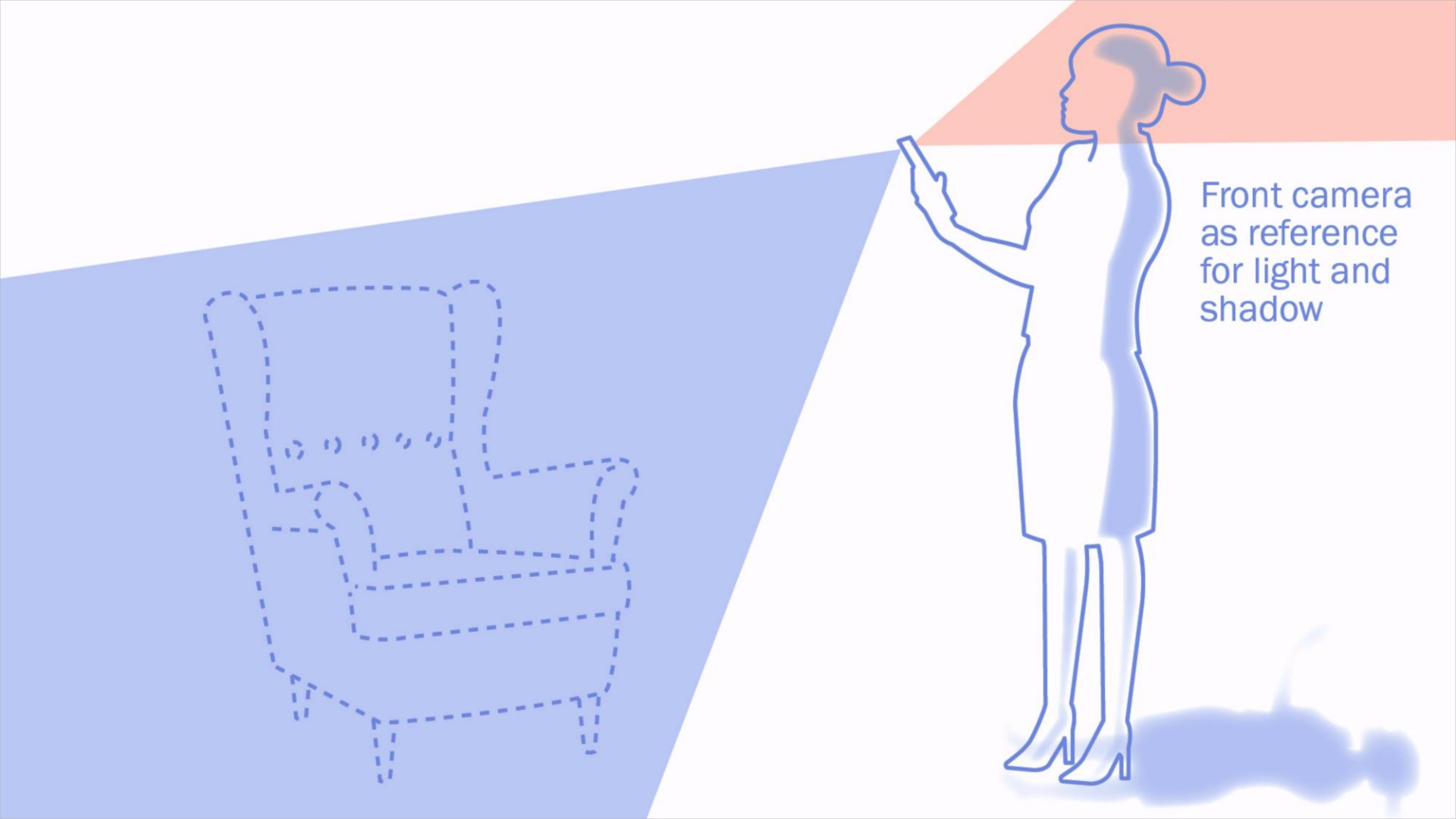
ILLUMINATION ESTIMATOR


metaio
ISMAR
2014
Real-Time Estimation of Grayscale Illumination

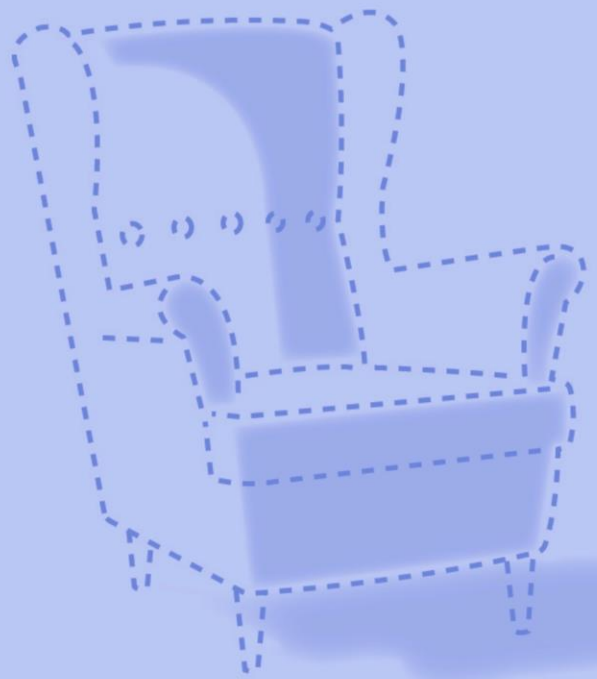
AR Furniture

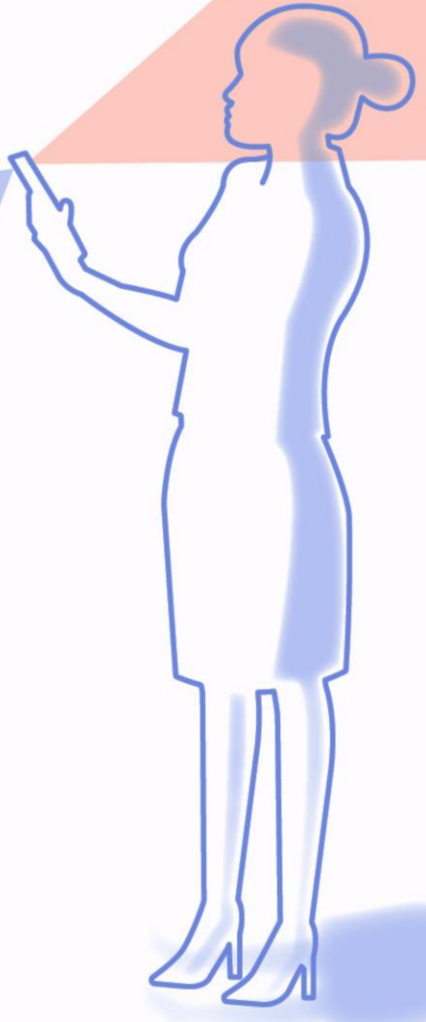


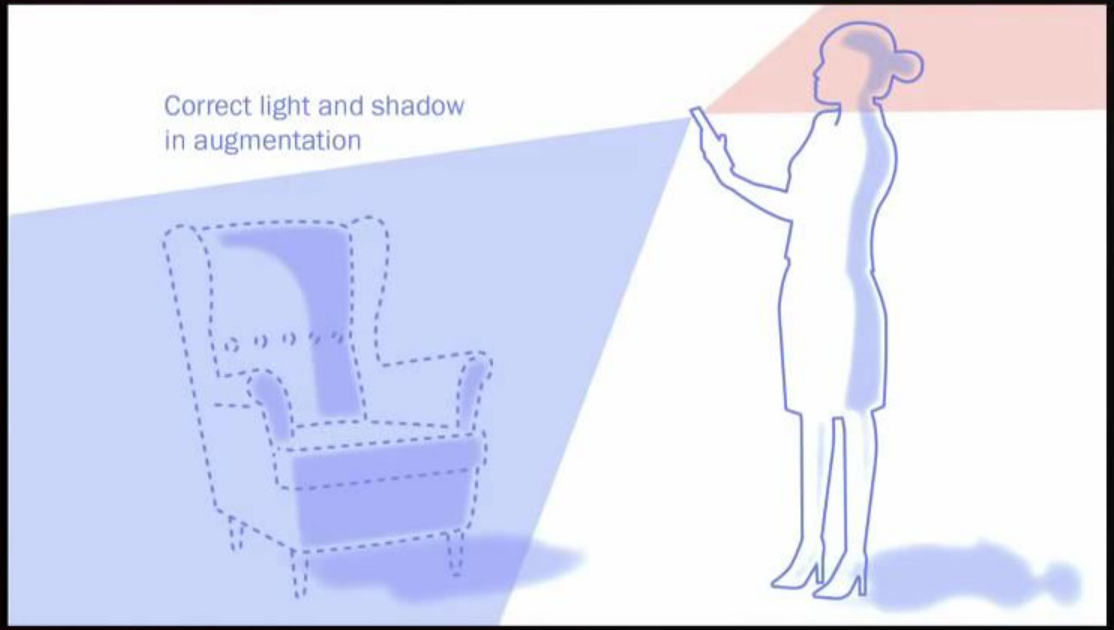



Front camera
as reference
for light and
shadow

Correct light and shadow
in augmentation







INSIDE AR AUGMENTED REALITY CONFERENCE

- New sensors means more data and more information.
- In order to exploit data and information we need more computational power.
- GPU can alleviate the computation traditionally performed by the CPU.
- Data + Computation Power

➔ Seamless AR experience.

Always on, always augmented

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