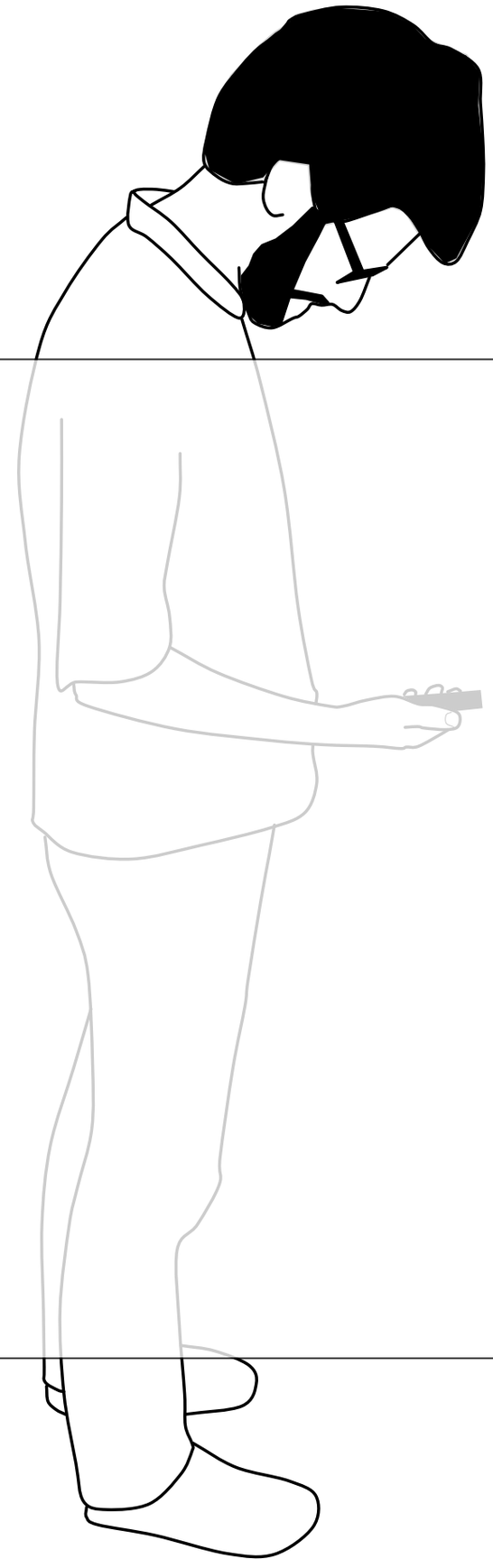
Mobile Technologies



context and task

theory

interaction techniques

in/output technologies

Sensors

- gyroscope
- accelerometer
- magnetometer

- always available mobile input
  - SixthSense project
  - EMG (Skinput)

SixthSense Project

- vision-based approach for always available input

https://www.youtube.com/watch?v=JnxGUPzP_U0

Literature: Mistry, P. : Wear Ur World - A Wearable Gestural Interface, CHI 2009

Biosensors

- signals traditionally used for diagnostic medicine
  - emotional state: heart rate, skin resistance
  - brain sensing technology cognitive and emotional state (BCI - brain computer interaction):
    - electrocephalography (EEG)
    - functional near-infrared spectroscopy (fNIR)
  - signals generated by muscle activation
    - electromyography (EMG)
    - bone conduction
      - sound frequencies propagate well through bone

Brain-Computer Interfaces

- context and task
- theory
- interaction techniques
- **in/output technologies**
  - **sensors**
    - HMD
    - fabrication
    - teaching
    - shape-changing
    - mobile projection

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Mobile

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The *annoyingly* talking window

https://www.youtube.com/watch?v=azwL5eoE5aI

Skinput

- Bio-sensing approach
  - leverages natural acoustic conduction properties of the human body

https://www.youtube.com/watch?v=g3XPUdW9Ryg

Head-Mounted Display

- Principles
  - closed HMD
  - VR with HMD
  - AR with see-through
    - video
    - optical
      - google glasses
- Head-up Displays with head tracking
- oculus rift

Google glasses and augmented reality

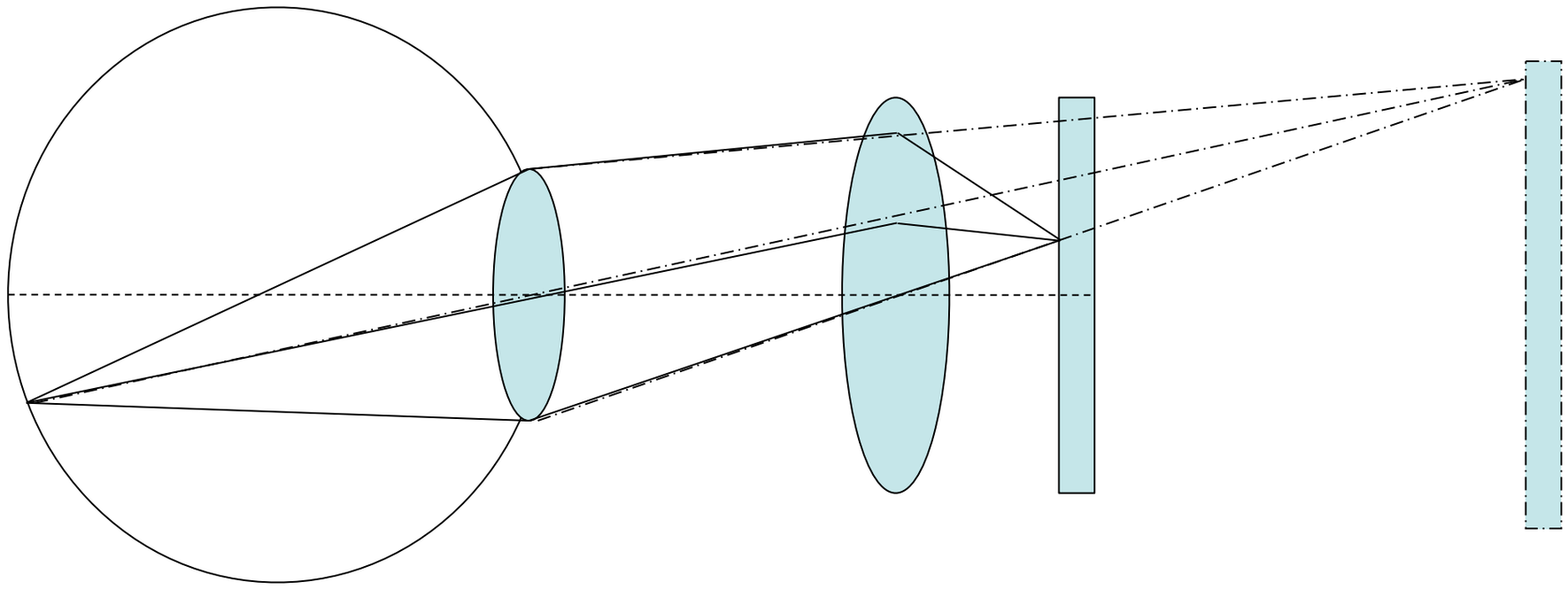
http://www.tomsguide.com/us/google-glass,news-17711.html

Ivan Sutherland, 1968

http://louislau91.files.wordpress.com/2013/06/sword_of_damocles.jpeg

Principle: closed (video only) HMD

- Monitor is mounted very close to the eye
- Additional lens makes it appear distant
- ➔ all images appear at the same distance
  - Usually at infinity or slightly less



Creating VR with a HMD

- context and task
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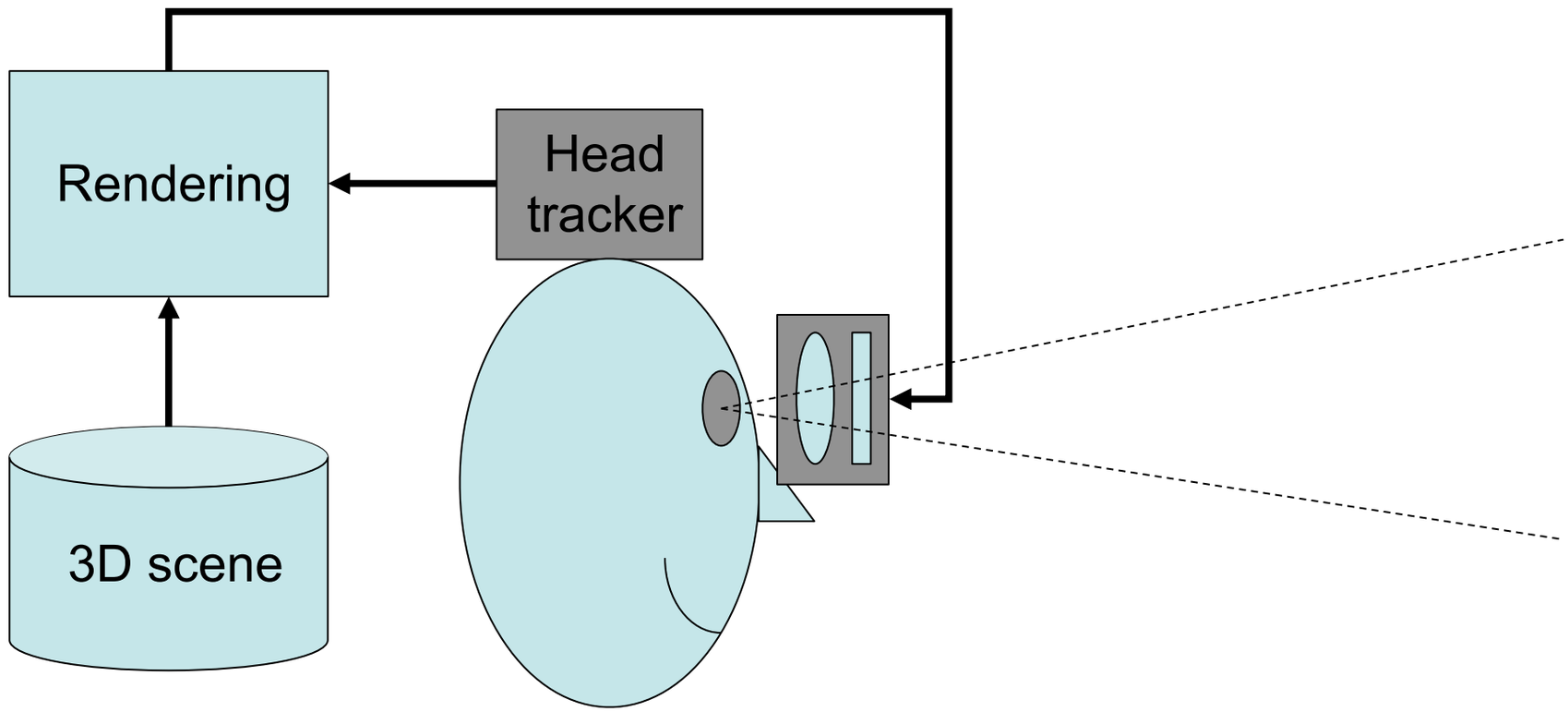

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Challenges with HMDs in VR

- Lag and jitter between head motion and motion of the 3D scene
  - Due to tracking → predictive tracking
  - Due to rendering → nowadays mostly irrelevant
- Leads to different motion cues from
  - Eye (delayed) and
  - Vestibular system (not delayed)
- Result: cyber sickness

Oculus Rift

- costom-built motion and orientation sensor unit
  - gyroscope
  - accelerometer
  - magnetometer
- head tracking with 3 degrees of freedom

http://static3.businessinsider.com/image/51d1949aecad04ad3e000000/heres-what-happened-when-we-strapped-a-bunch-of-people-into-the-oculus-rift-virtual-reality-headset.jpg

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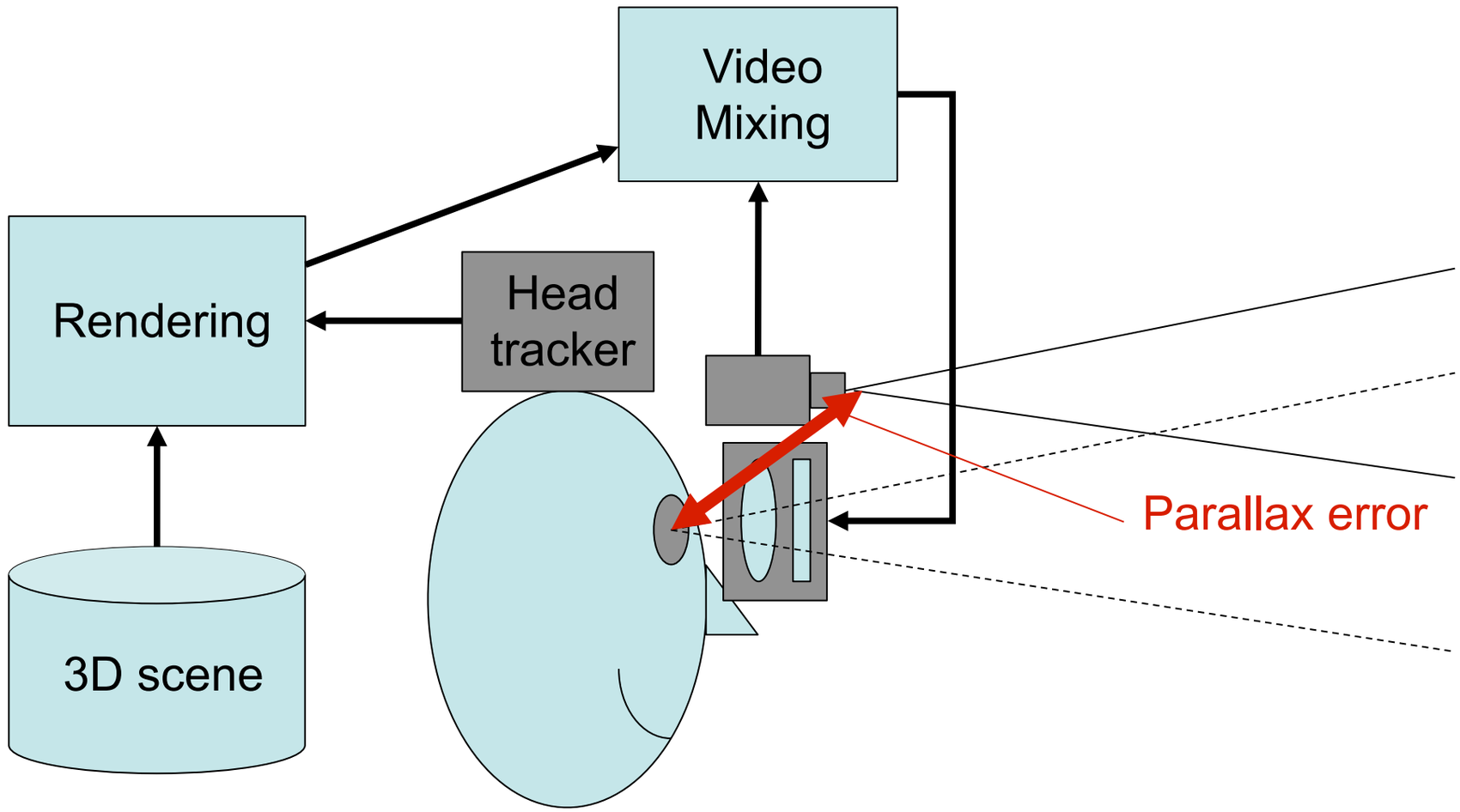
Creating AR with video see-through HMDs



Advantages of video-based see-through

- Lag between physical and virtual image can be compensated
- Camera can be used for tracking as well
  - Physical image = raw tracking data
  - Perfect registration possible
- Video mixer can add or subtract light
  - Virtual objects can be drawn in black
  - Physical objects can be substituted
  - Virtual objects can be behind physical objects
- Just one image with a given focus distance

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Challenges of video-based see-through

- Lag between physical and virtual image can be compensated
  - …by delaying the physical image
  - Leads back to the cyber sickness problem
- Parallax error can not be corrected electronically
  - Wrong stereo cues when used for stereo
- Richness of the world is lost
  - Video image just 0.5 megapixels
  - Resolution of human vision is much higher (>10x)

Creating AR with optical see-through HMDs

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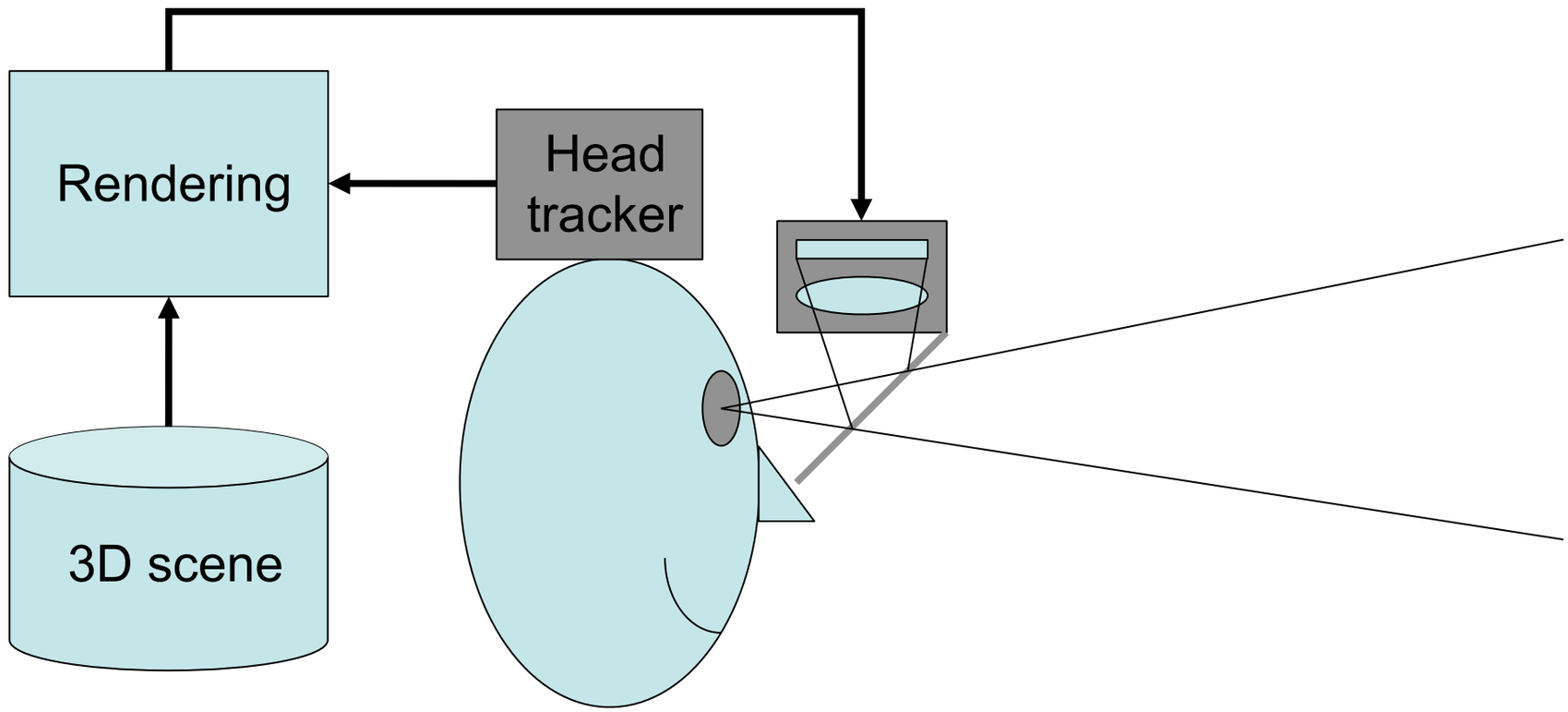

Advantages of optical see-through HMDs

- Preserve the richness of the world
  - Very high resolution of physical image
  - No lag between motion and phys. image
  - Physical objects can be focused at their correct distance

- Limitations:
  - can only add light, i.e. not cover things
  - lag of digital image very noticeable

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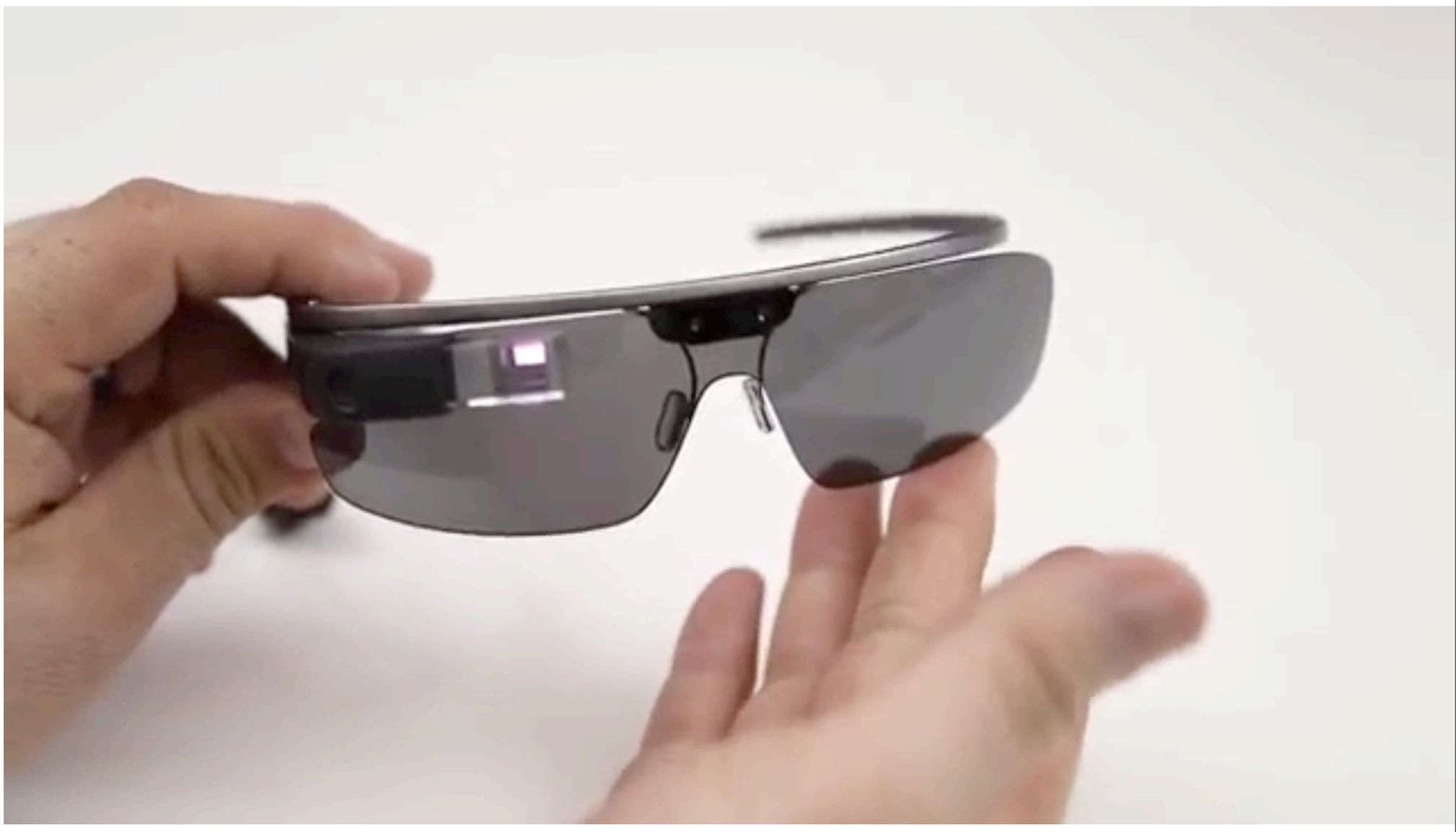
Example: Google glass



http://www.youtube.com/watch?v=Ee5JzKbOAaw

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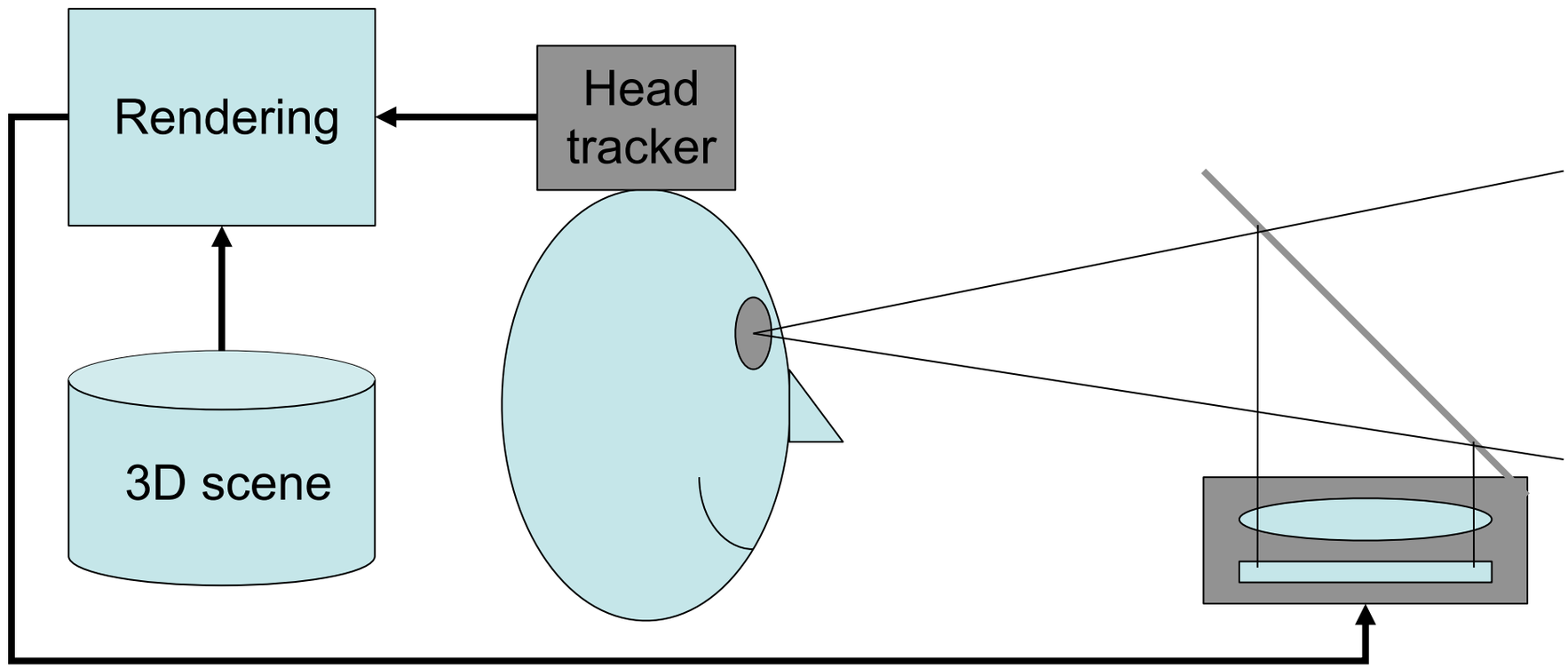
Creating AR with Head-up Displays (HUDs)



Head-Up Display with 3D registration

- Currently mostly military use
- Fixed Display
- Very exact head or eye tracking needed
  - Easy for jet pilots
- High brightness and dynamics needed

HUD without 3D registration

- Optional Equipment in premium cars (image source: www.bmw.ch)
- easy: no tracking needed! -> not AR!

HUD app for iPhone

- can be bought from app store
- put iPhone under wind shield
- uses GPS and accell sensors to sense car motion
- can display speed, heading, ...

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Fabrication, know your tools...

- know your tools...
- further development of
  - Laser-cutting
  - 3D printing

Laser Origami

- laser cut objects without assembling...

https://www.youtube.com/watch?v=arjRtCjI9AQ

Literature: Müller, S. : Laserorigami: Laser-cutting 3D Objects, CHI 2013

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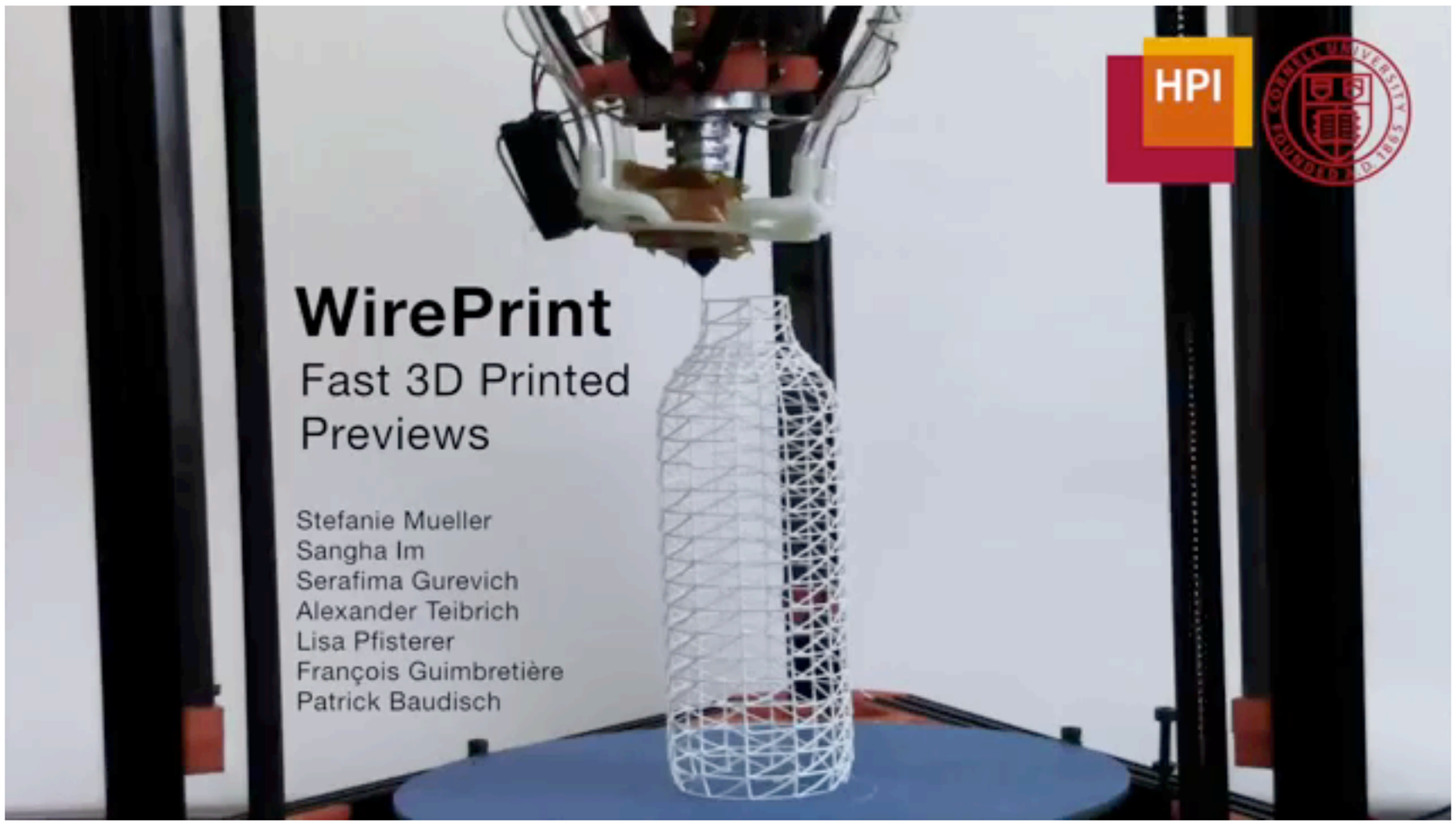
WirePrint



https://www.youtube.com/watch?v=Ea4V7kb2VsY

Literature: Müller, S. : WirePrint:3D Printed Previews for Fast Prototyping, UIST 2014

3Doodler

- next step to 3D printing... 3D sketching

https://www.youtube.com/watch?v=DQWyhezIze4

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Teach and Learn...

- Goal: support creative activities of children using educational toys.
  - tangibles
  - programming by demonstration concept

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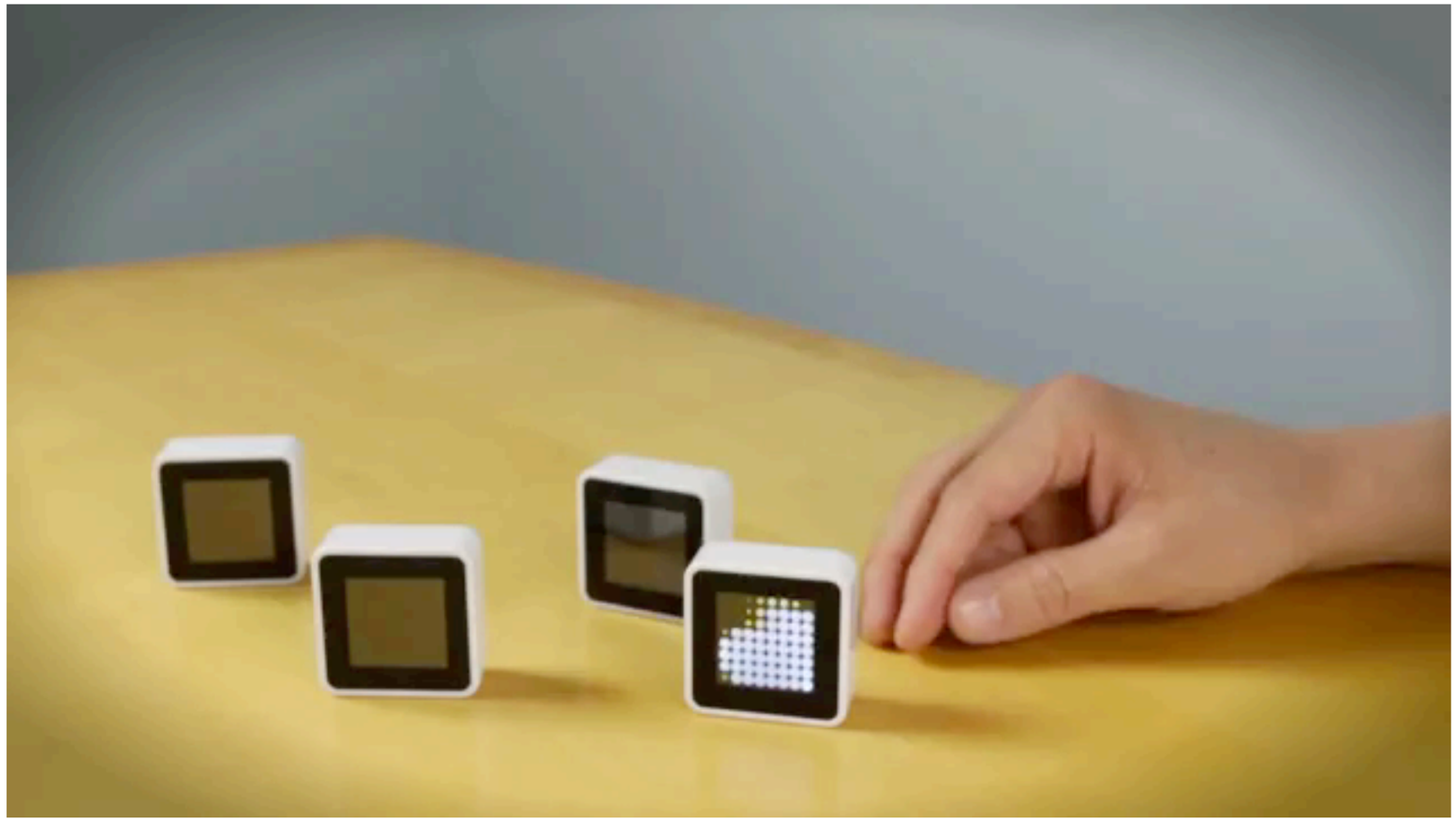
Sifteo Cubes



https://www.youtube.com/watch?v=fEqq8JykQoQ

Literature: Merrill, D. : Sifteo Cubes, CHI 2012

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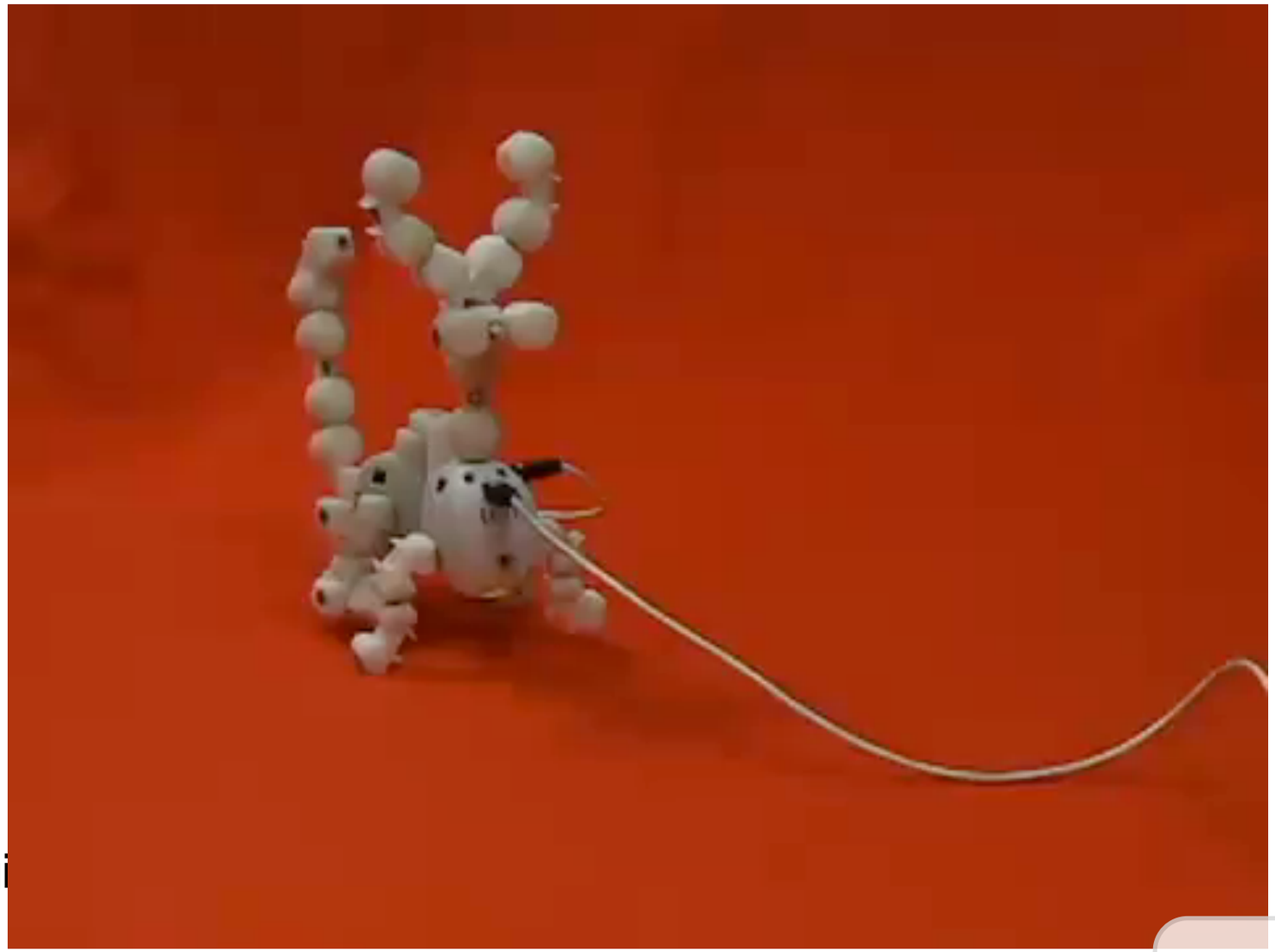
Programming by



Topobo System

https://www.youtube.com/watch?v=50JdK_K2NWk

iteratur: Raffle, H. ; Topobo: a constructive assembly system with kinetic memory, CHI

Squishy Circuits

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Literatur: Johnson, S. : Squishy circuits: A tangible medium for electronics education, CHI 2010

Shape changing displays

- MorePhone: flexible displays
  - using shape deformation as its primary means of both haptic and visual notifications
  - use OLED and shape changing alloy wires

Mobile

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MorePhone

Literatur: Gomes, A. : MorePhone: An Actuated Shape Changing Flexible Smartphone, CHI 2013

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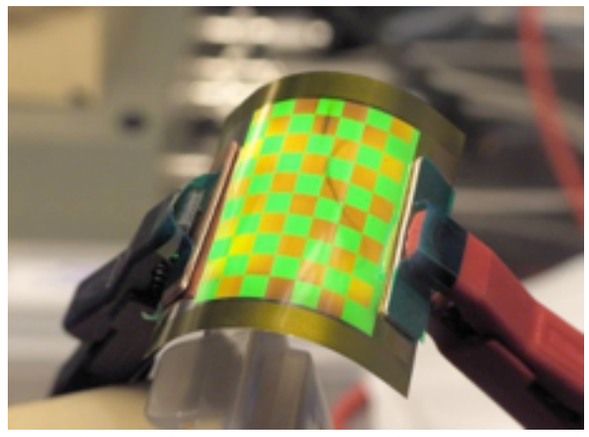
OLED - organic light-emitting diode

- applied: PDAs, photo-camera, phones
- elements: two electrodes (one of them transparent), layer of OLED-material
- idea:
- ‘+’: thin construction allows fabrication of flexible displays on e.g. plastic foil, no backlight, higher contrast ratio
- ‘-’: not all colors shine with same efficiency, on-going research on optimum OLED-materials

http://www.blogcdn.com/www.engadget.com/media/2009/01/sony-oled-top002.jpg



http://www.igm.uni-stuttgart.de/forschung/arbeitsgebiete/oled/index.en.html

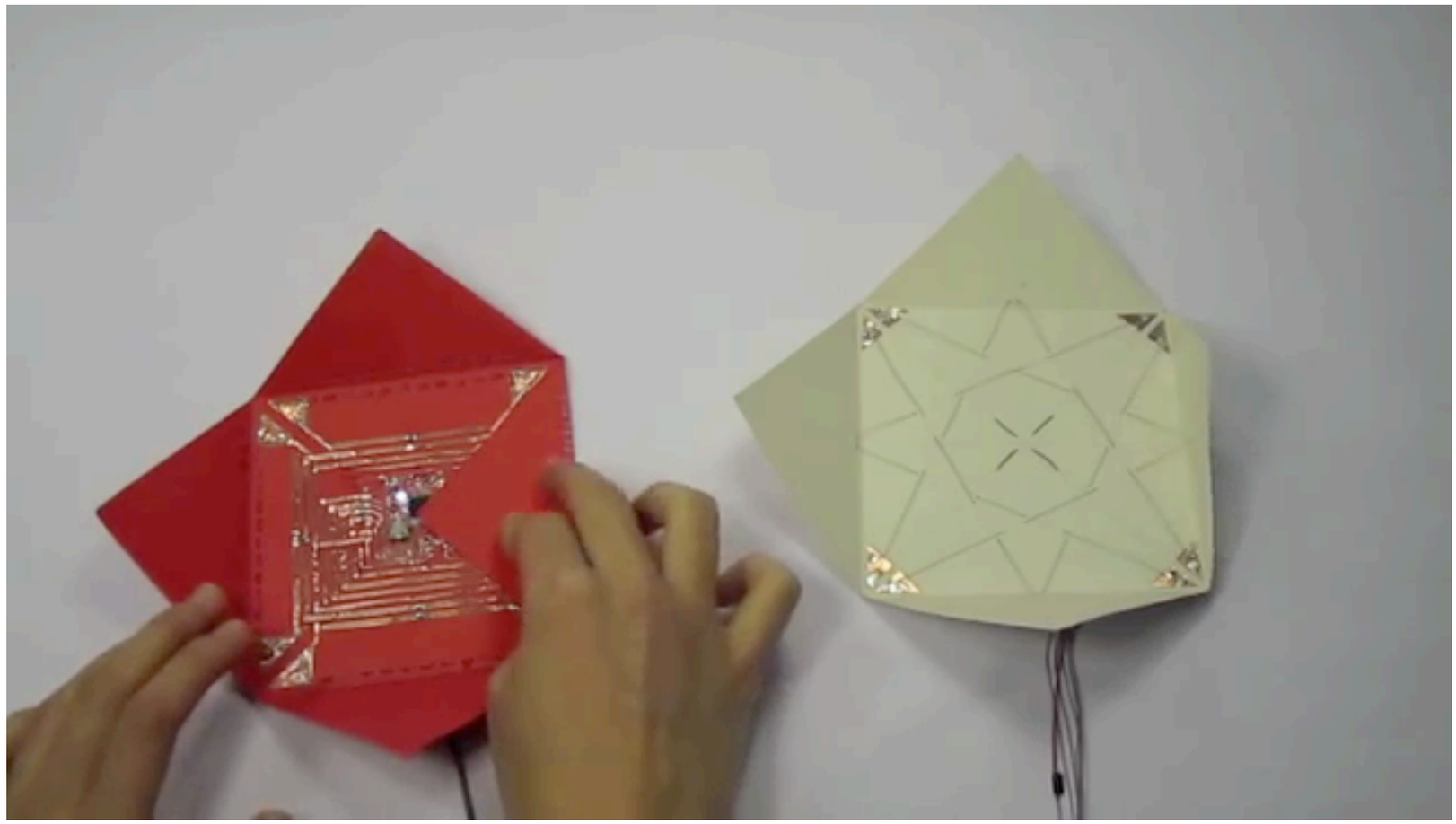
Shape Memory alloy wires

- shape memory effect
  - jumps back into ‘programmed shape’ when heat energy is applied
- two-way shape memory effect
  - springs into other shape when cooled down.

https://www.youtube.com/watch?v=JKBM9my5eOA

Shape Memory alloy wires

- Flexinol muscle wire
  - simple to hook up to a circuit
  - get inspired by the field of robotics (e.g. artificial muscles)



https://www.youtube.com/watch?v=VfOsPAkvOd0