Touch and Tangibles on Large Interactive Surfaces

Simon Voelker

Multi-touch Surfaces

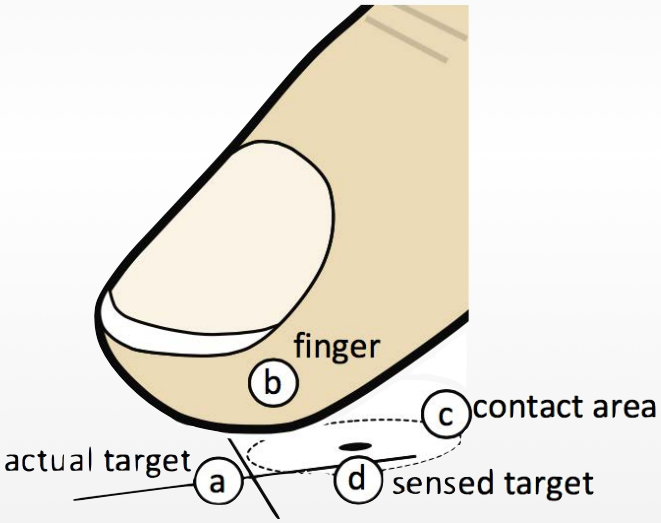
- Technologies
- Workplaces
- Tangibles on Interactive Surfaces

Why Multi-touch Surfaces?

- Single-touch is already very intuitive
  - Touch at locus of attention (direct touch)
  - No additional device is necessary
- Richer and more natural interactions
  - Multiple fingers of one hand
  - Two-handed interaction
- Further step towards Ubiquitous Computing
  - Enables multi-user interaction
  - Tabletops already convenient working environment
  - Awareness

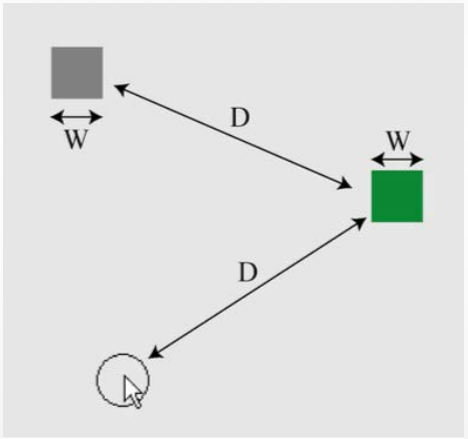
Problems with Touch Input

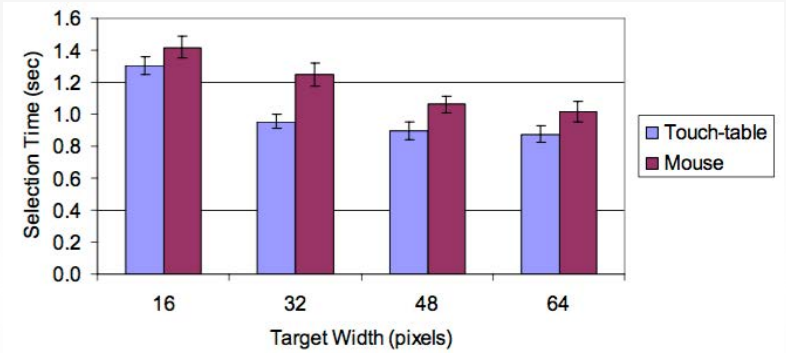
- Fat finger problem

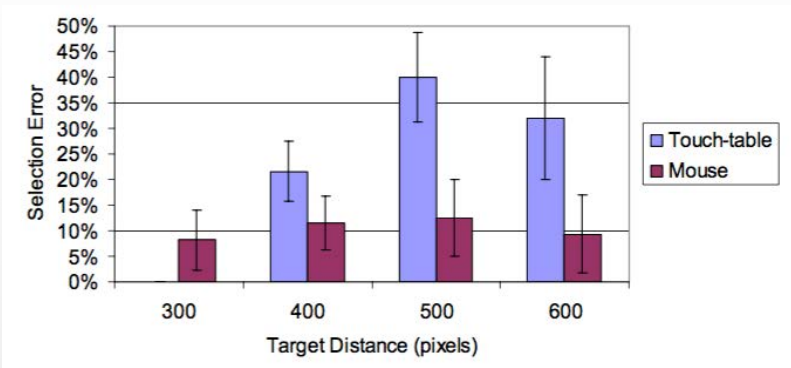


[Holz and Baudisch CHI '11]

- Fast but in inaccurate







[Forlines et al. CHI '07]

RWTH AACHEN UNIVERSITY

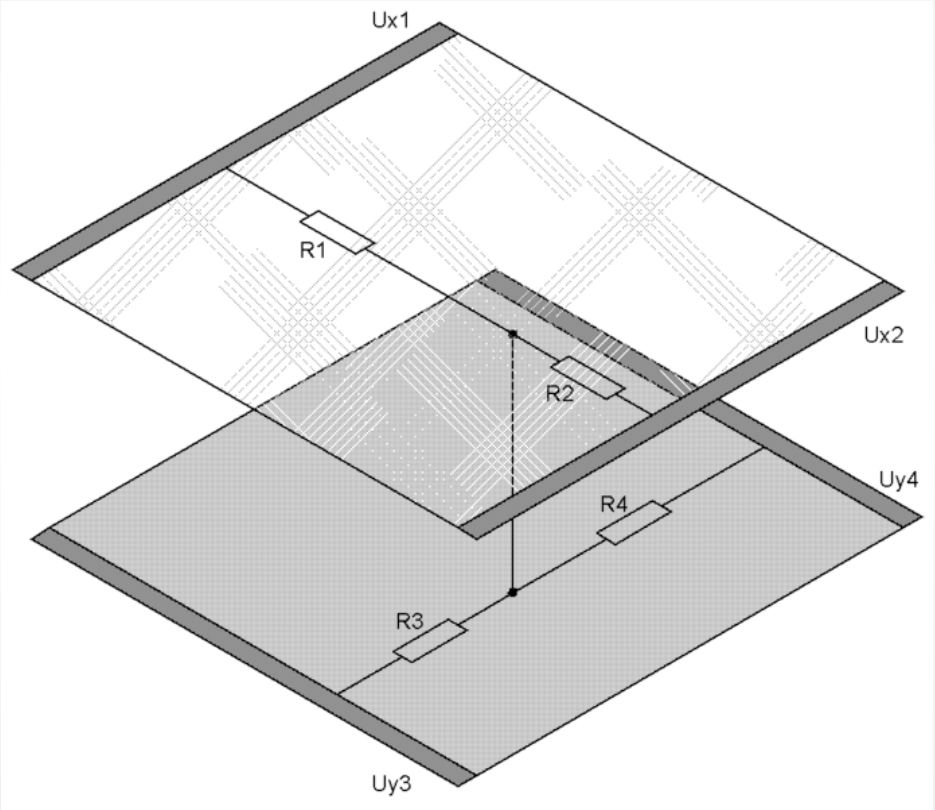
Technologies

- Resistive
- Vision-based
  - Frustrated Total Internal Reflection (FTIR)
  - Diffuse Illumination (DI)
  - Pixel Sense
- Capacitive

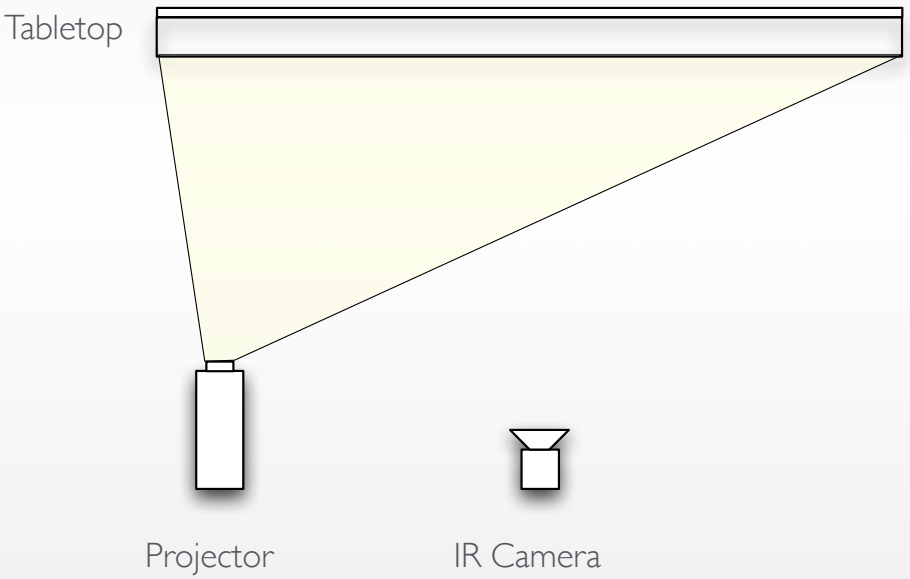
Resistive Touch Screens

- Flexible hard-coated outer membrane
- Conductive coating
- Insulating spacer dots
- Conductive coating
- Glass substrate

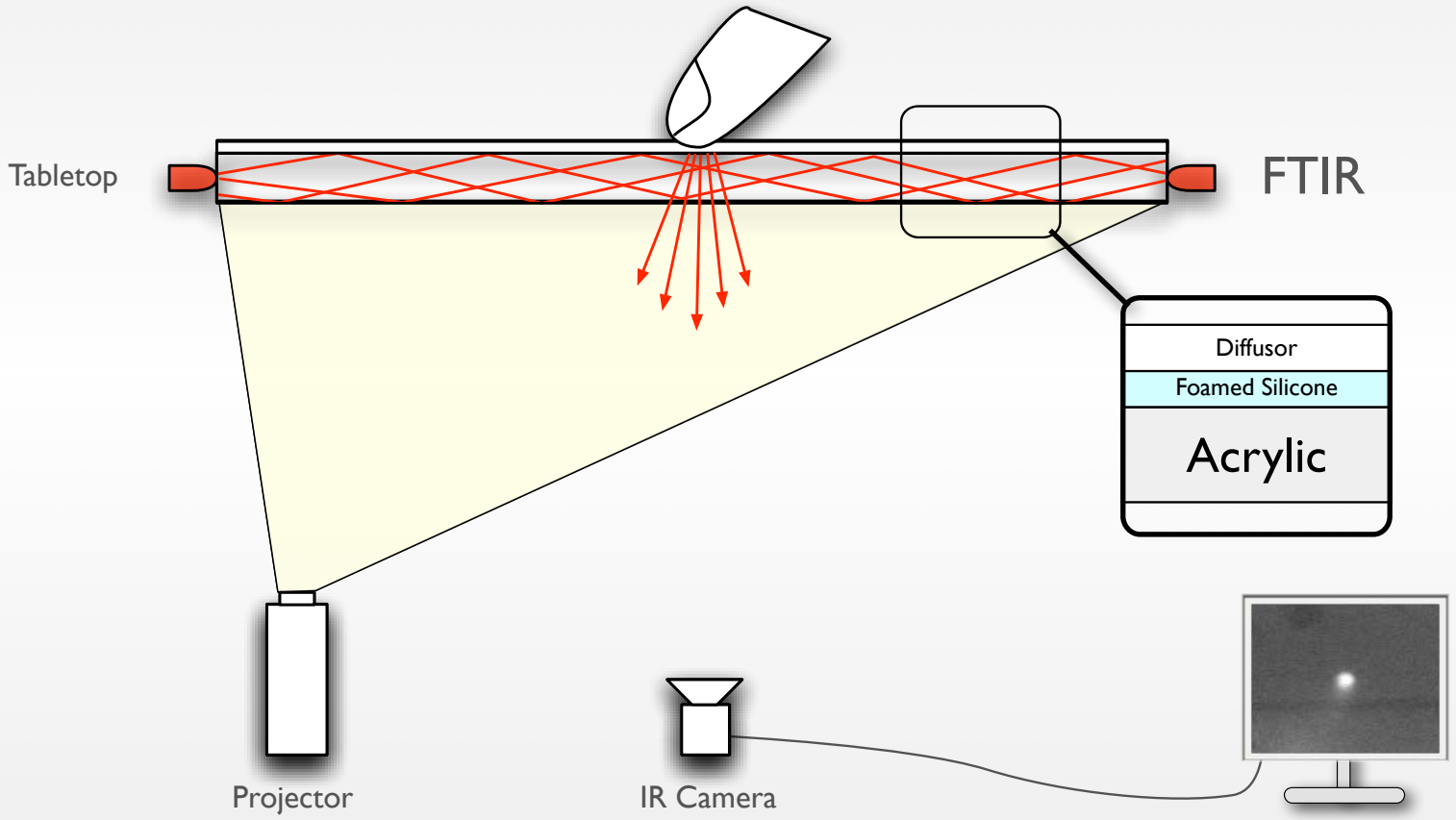
Resistive Touch Screens

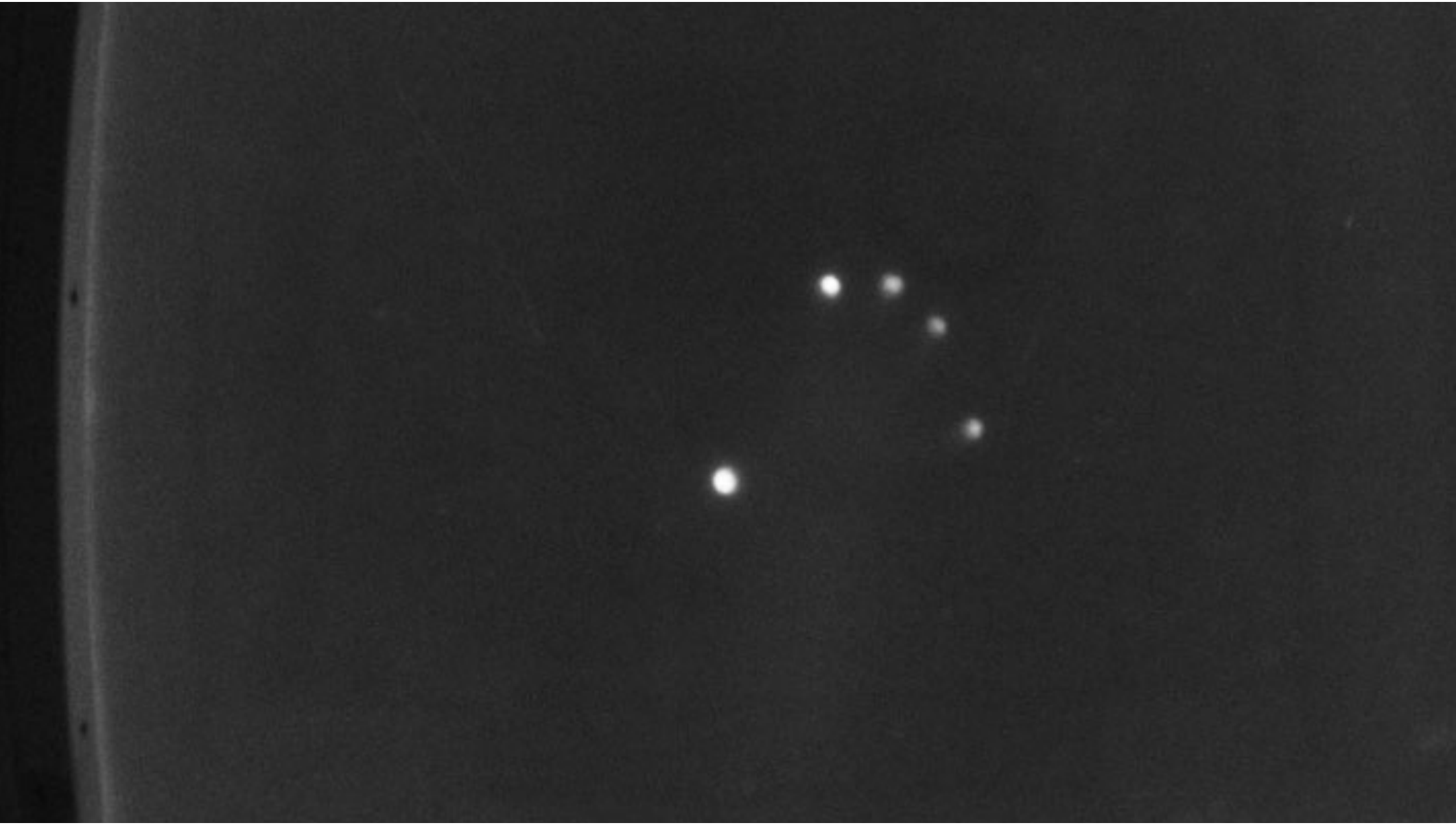


Vision-based Touch Screens

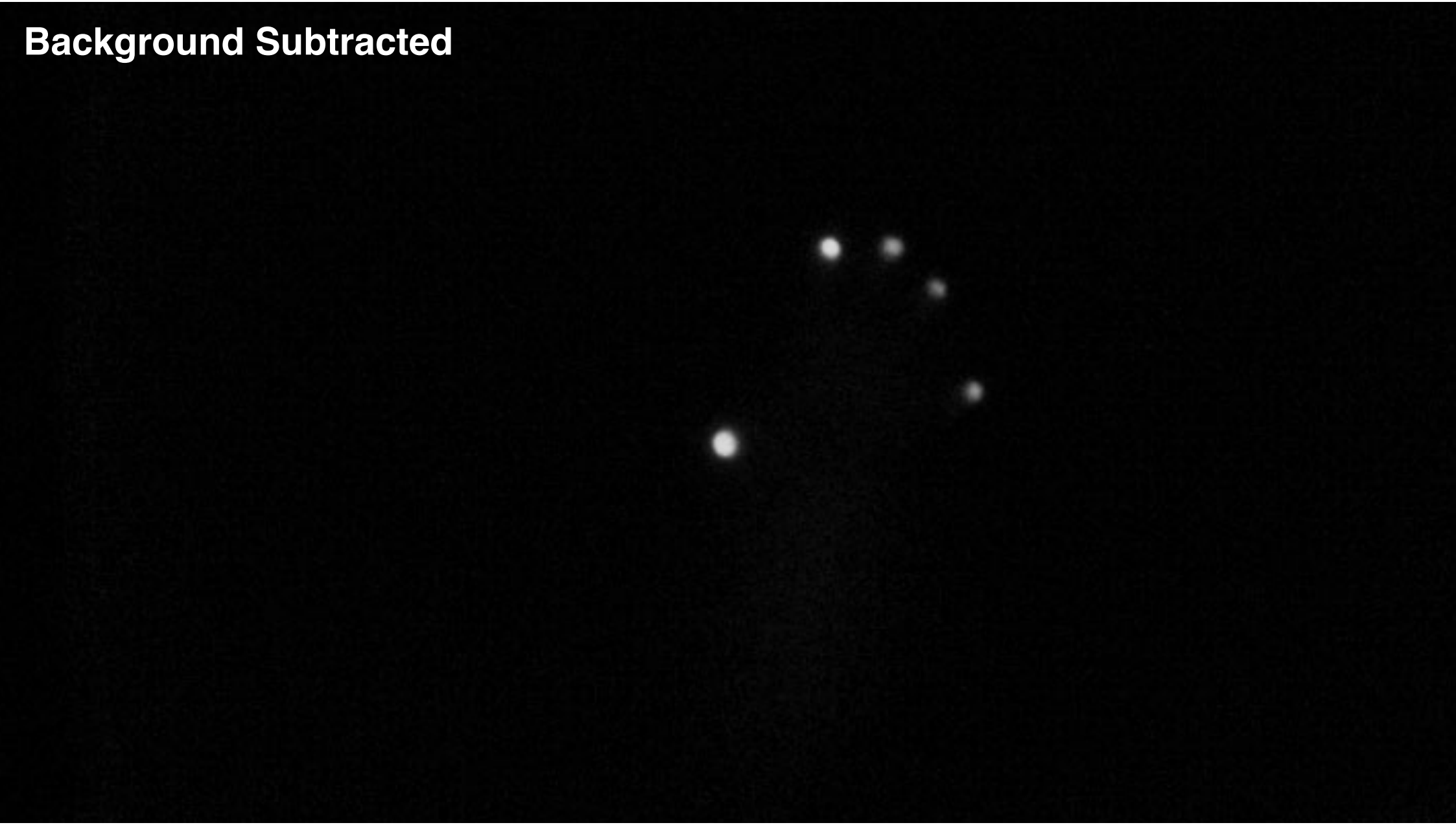


Frustrated Total Internal Reflection (FTIR)

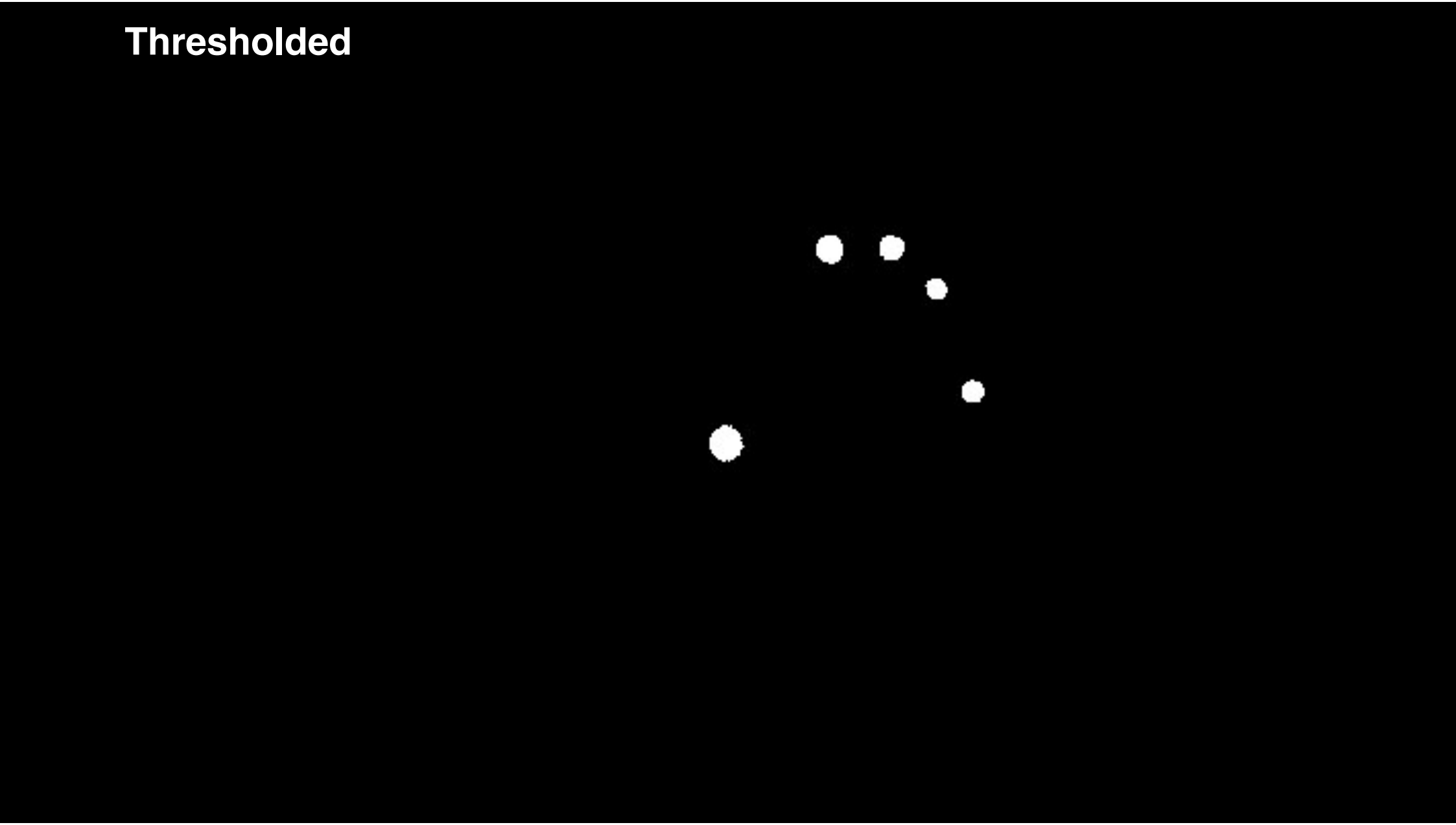




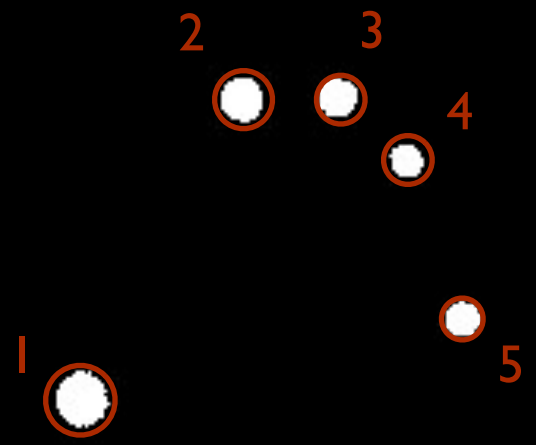
Background


Background Subtracted

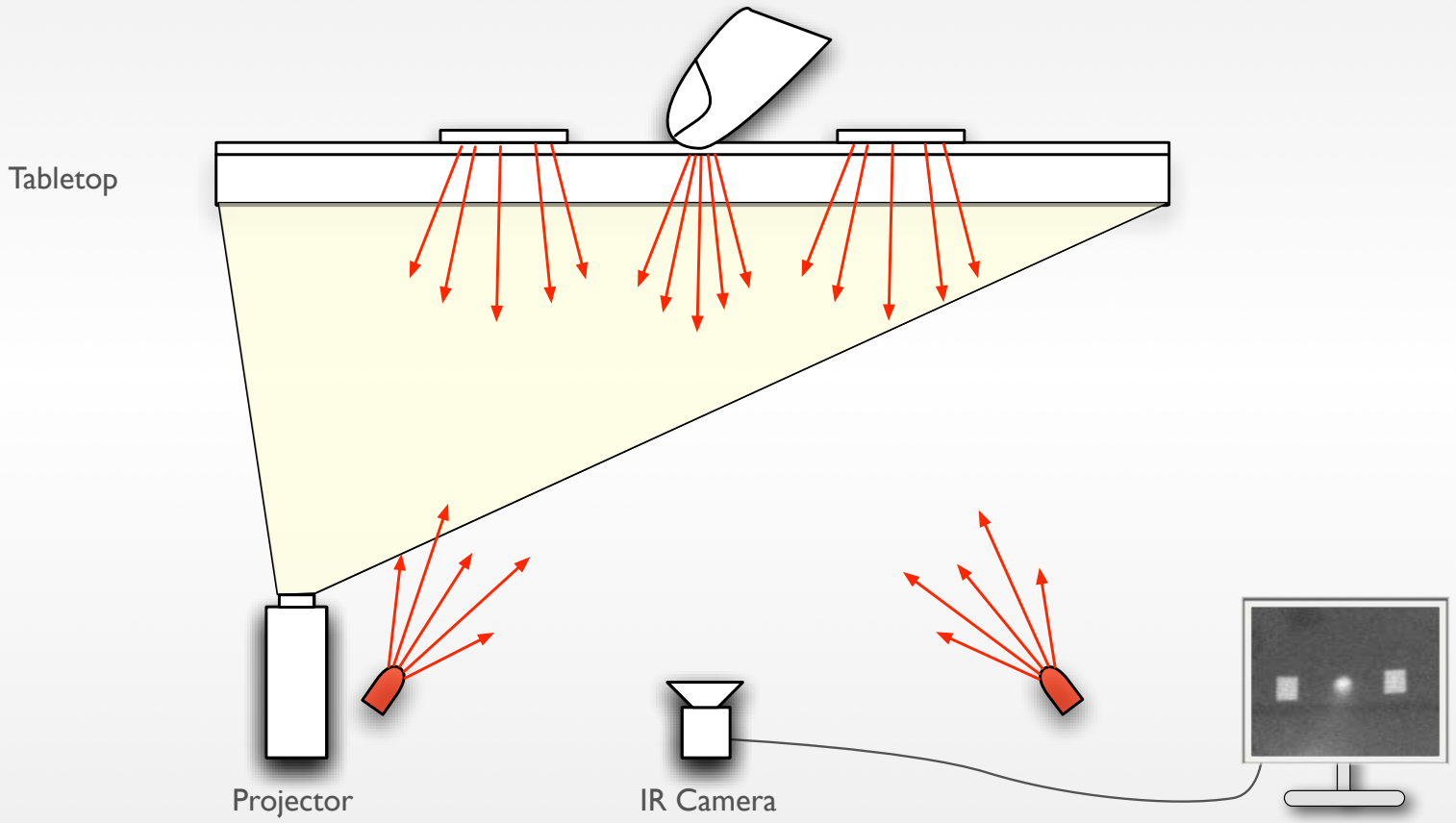
Thresholded



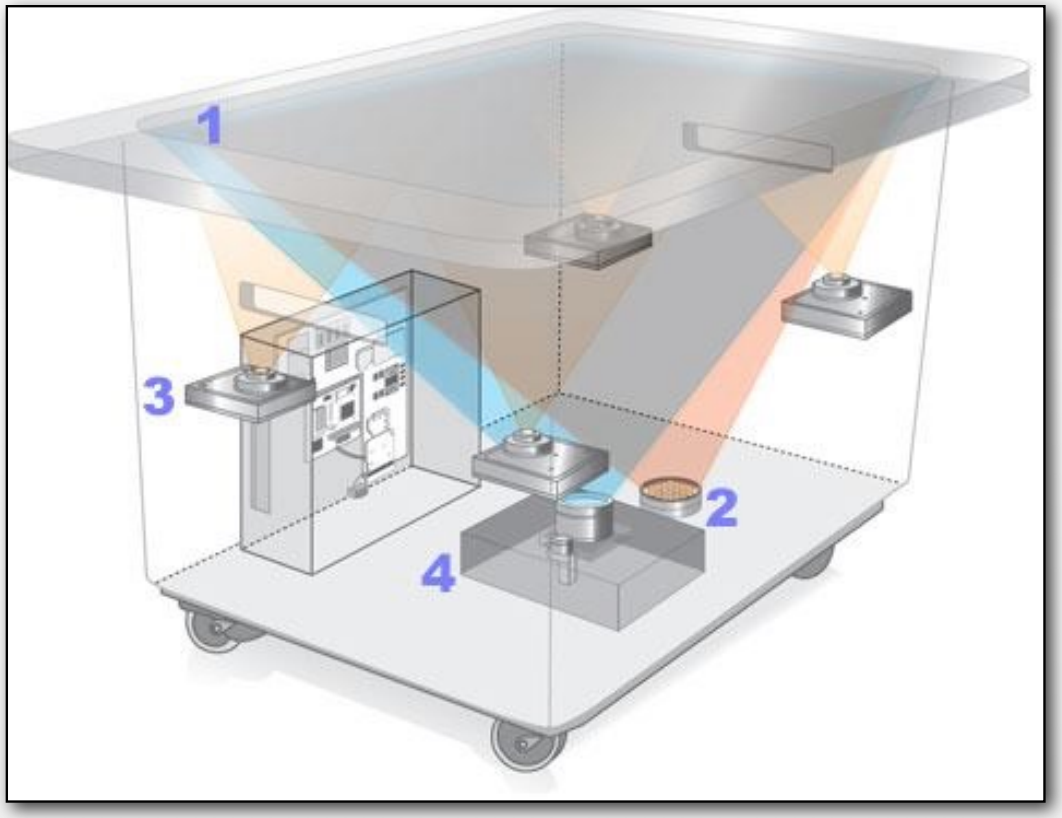
Detected Spots



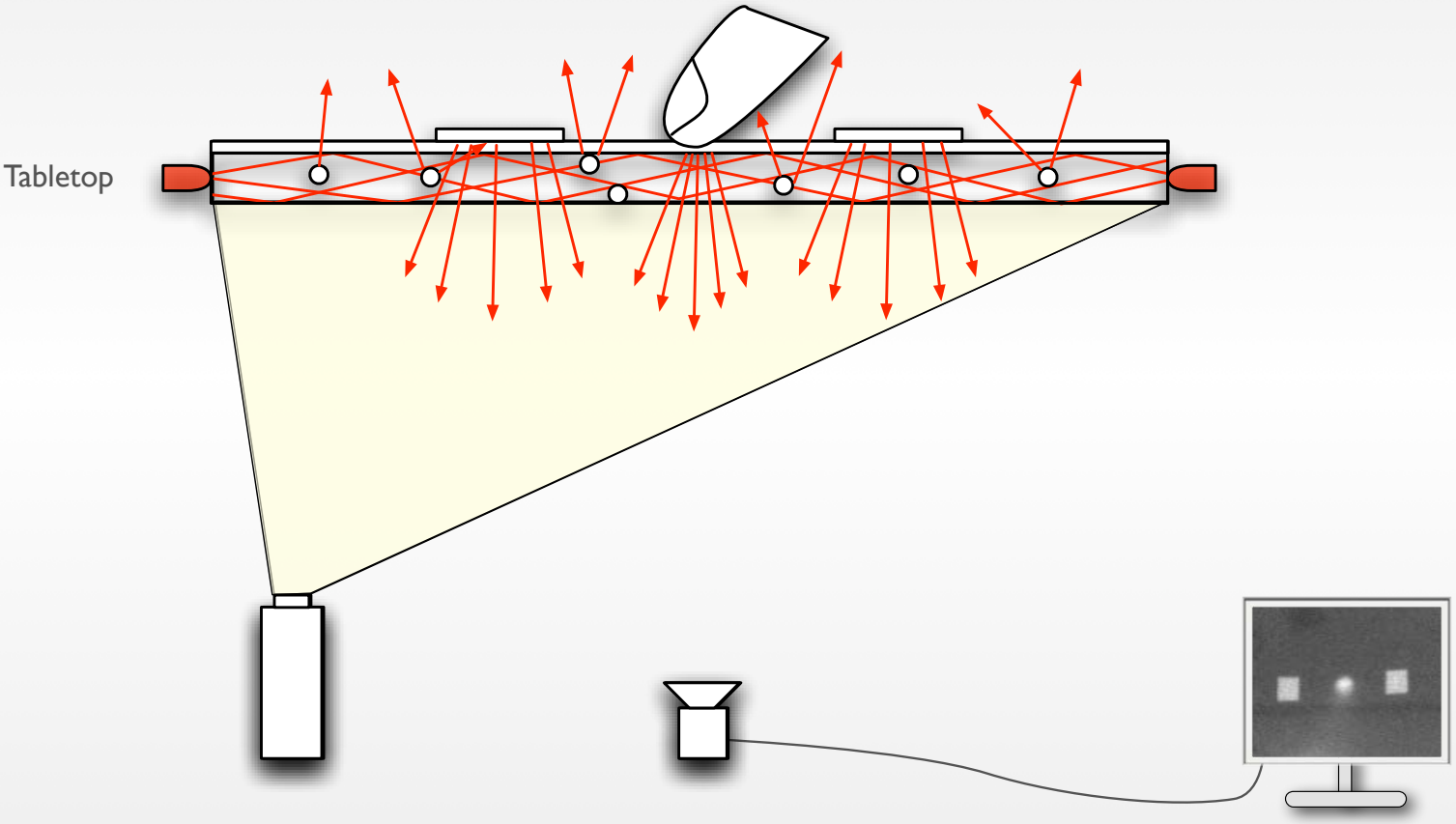
Diffuse Illumination (DI)



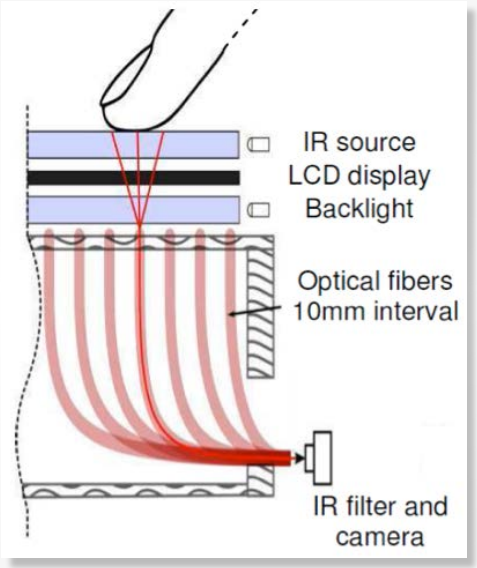
Example of DI: Microsoft Surface 1



Diffused Surface Illumination

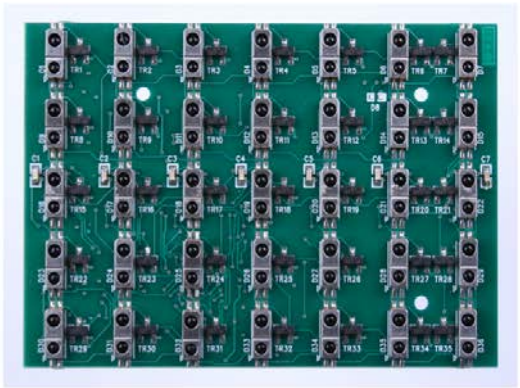


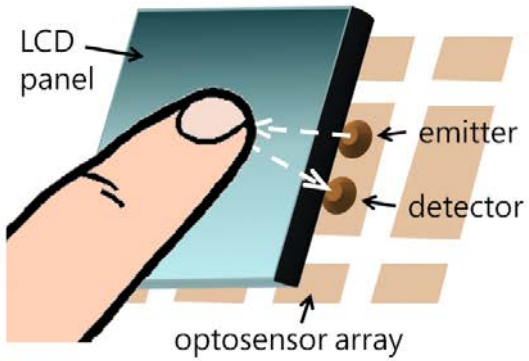
Reduced Form Factor

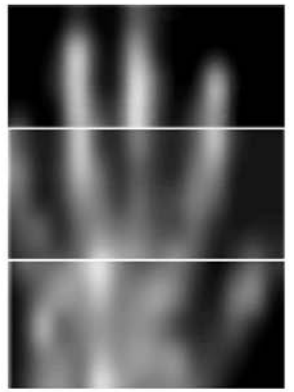


FiberBoard

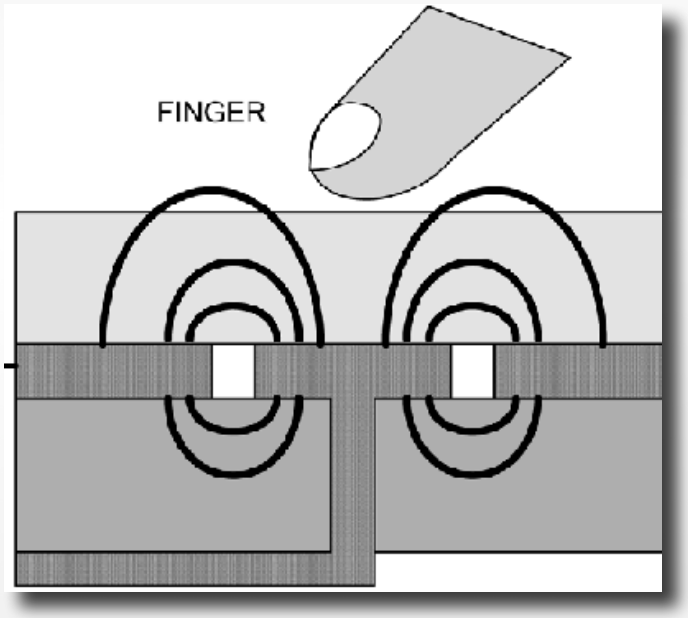
Microsoft Surface (Pixel Sense)





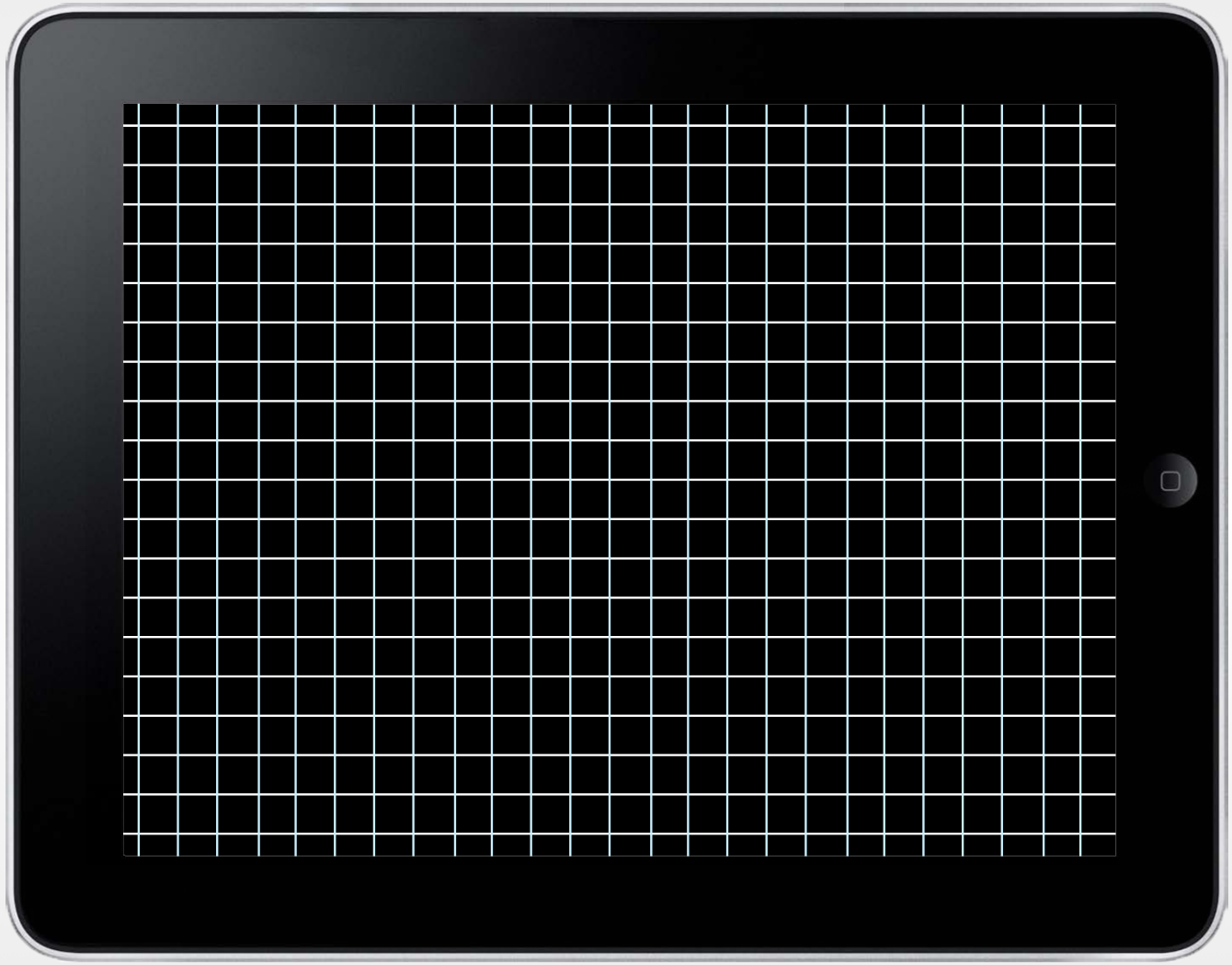


Capacitive touch



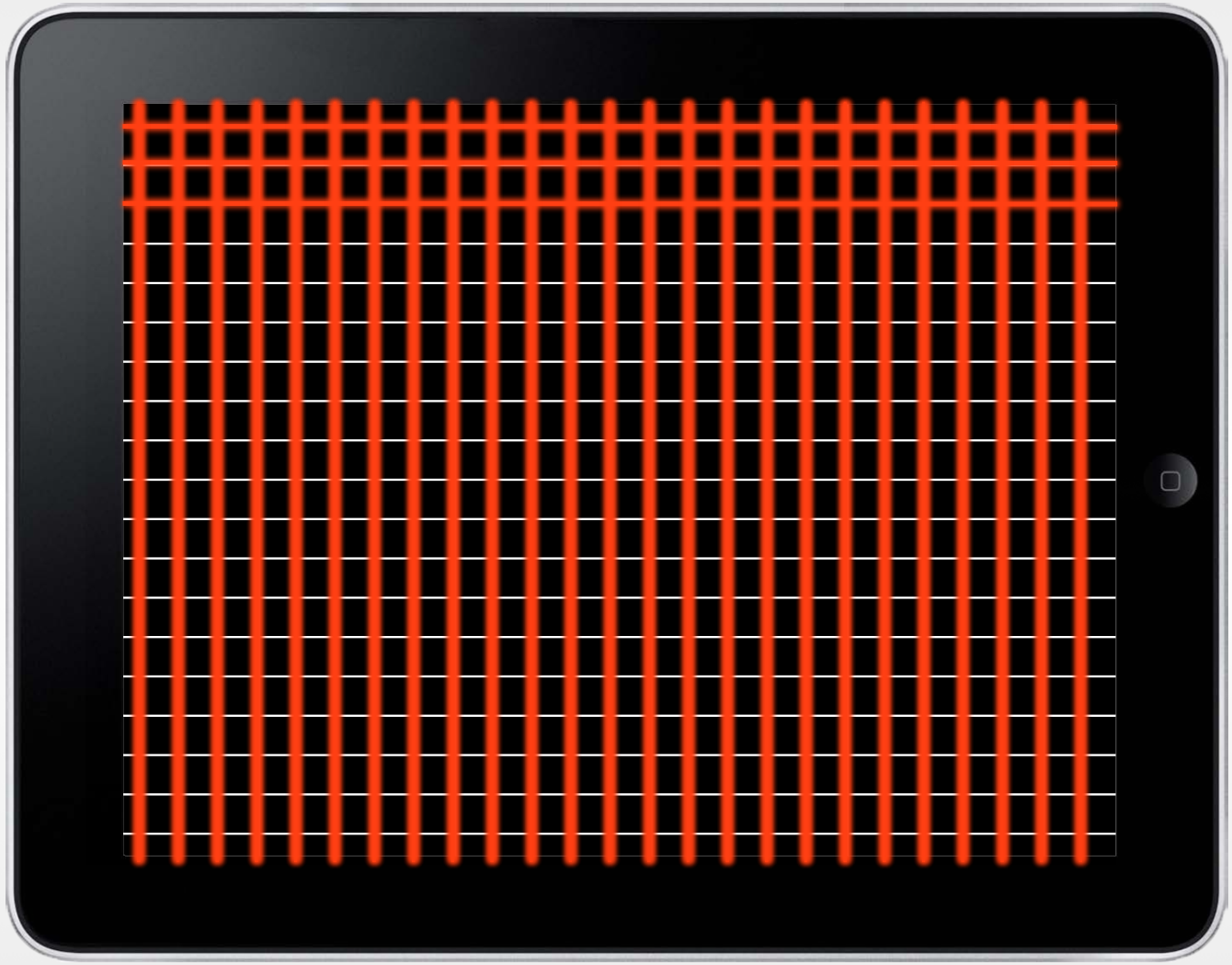
Receiving Electrodes

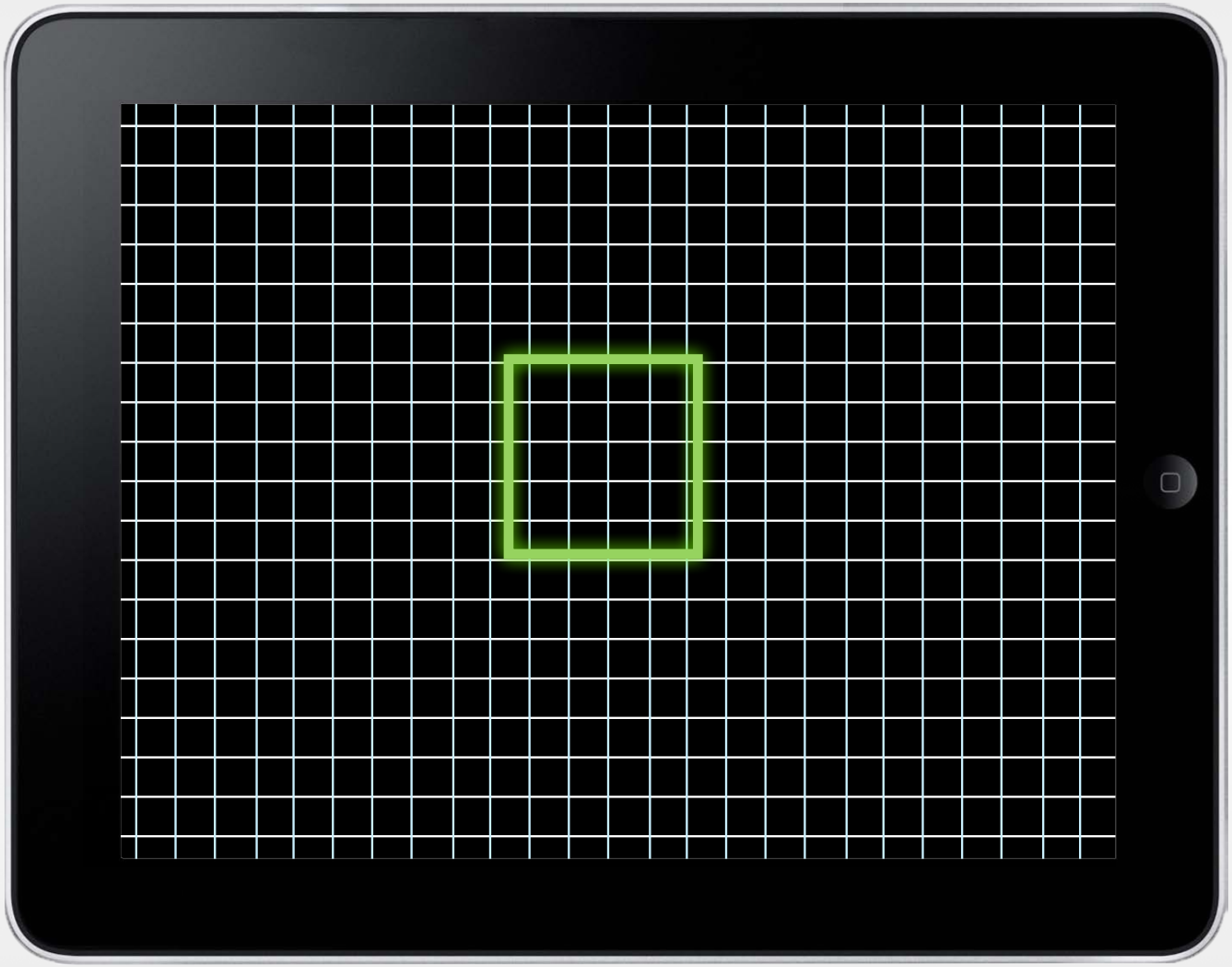
Transmitting Electrodes

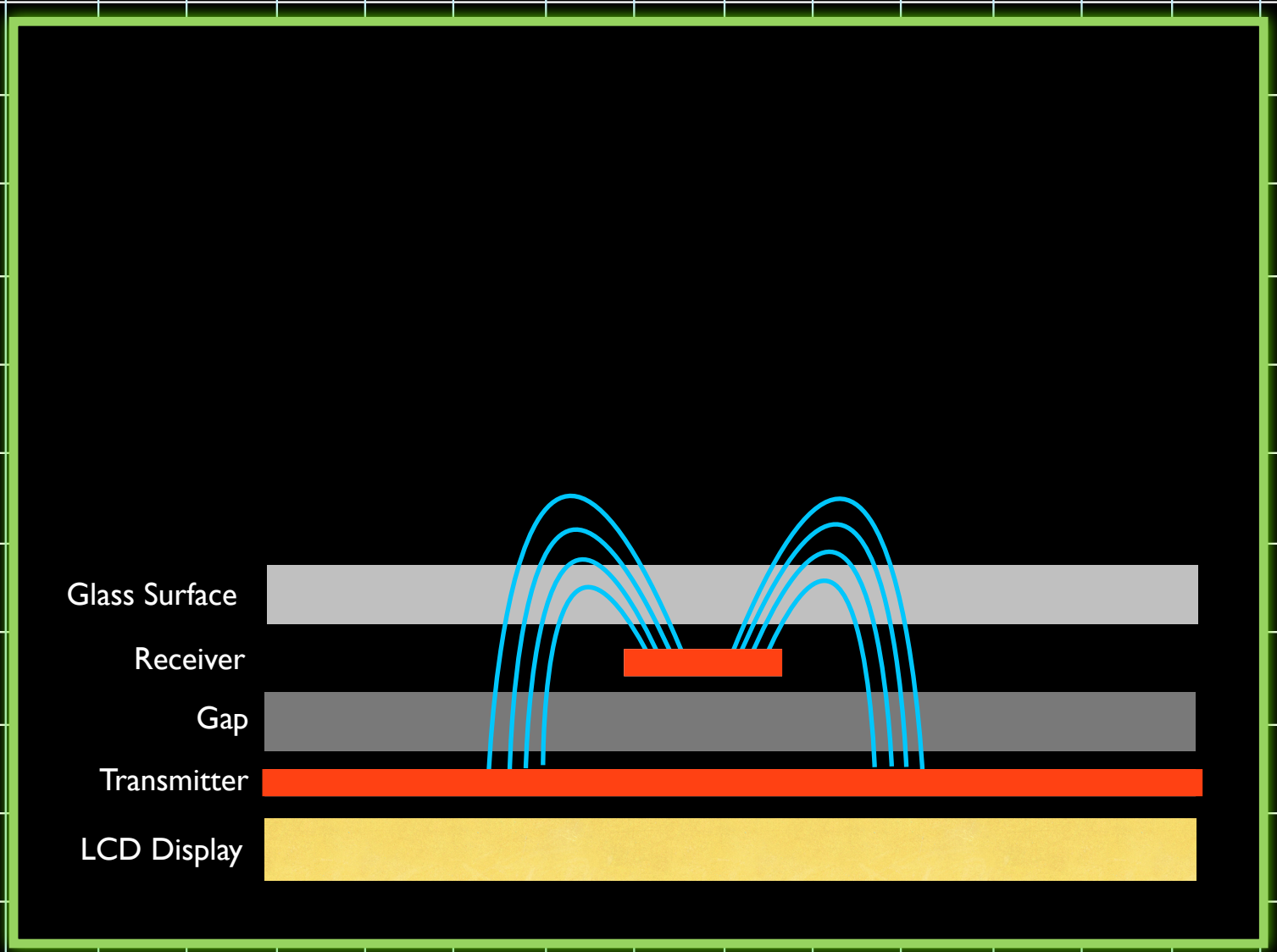


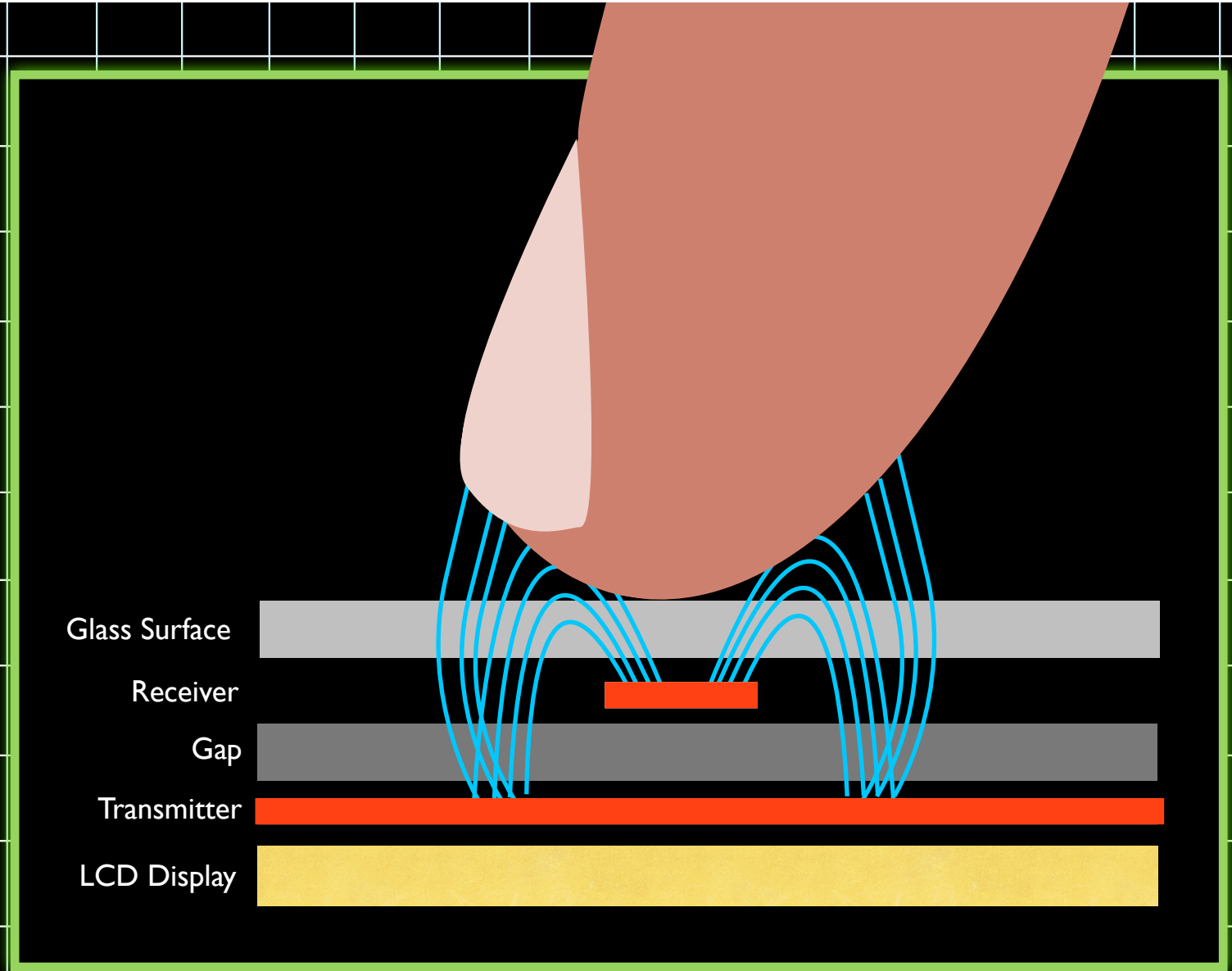
Receiving Electrodes

Transmitting Electrodes






Glass Surface
Receiver
Gap
Transmitter
LCD Display


Glass Surface
Receiver
Gap
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LCD Display

In-class Exercise: Predicting Future

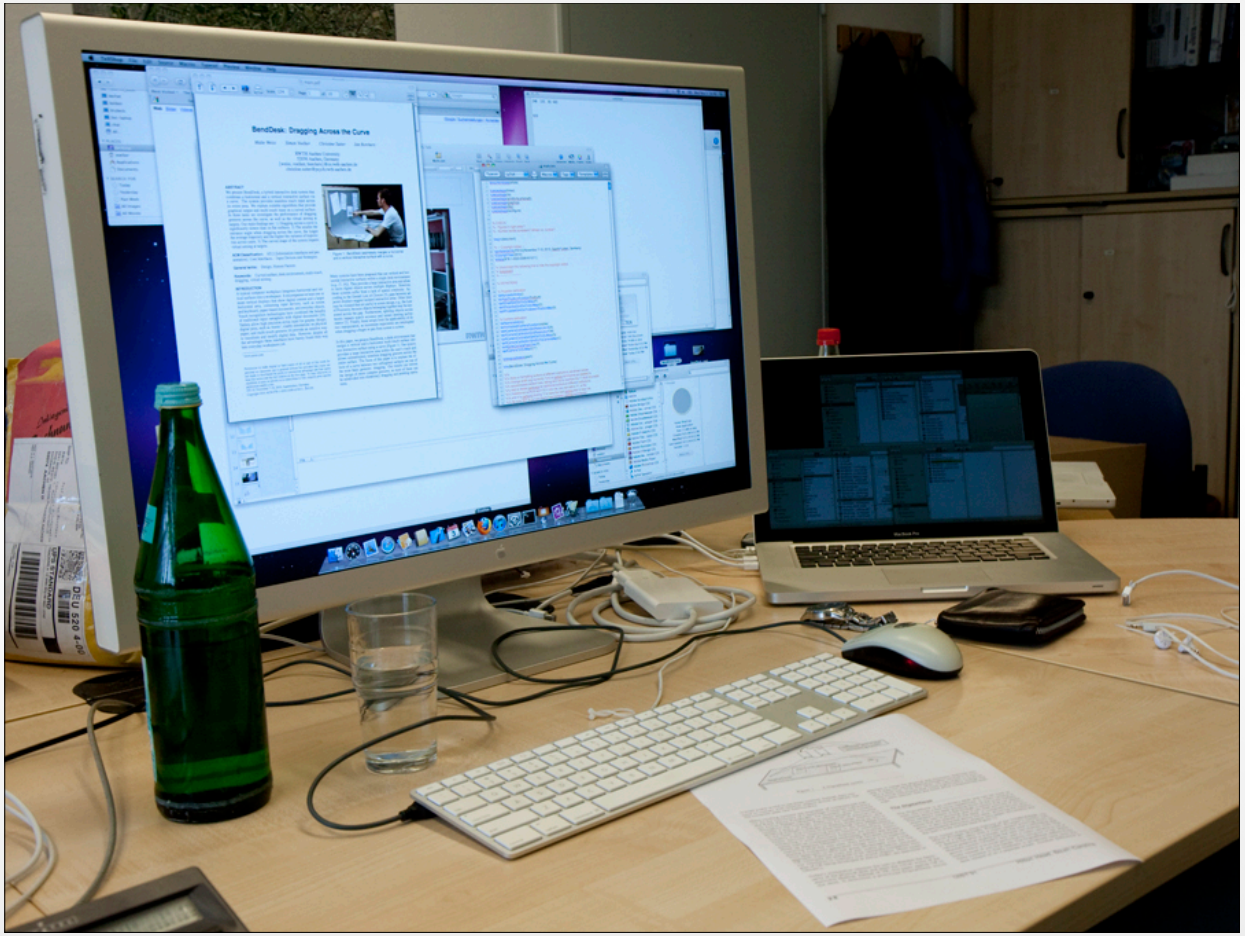
Will multi-touch interaction replace the desktop metaphor?

Multi-touch Workspaces

The DigitalDesk (Wellner, CHI '91)


Living with a Tabletop

Multi-touch Workspaces



Vertical vs. Horizontal Surfaces

- Vertical
  - + Good for reading task
  - + Good for overviews
  - – Gorilla arm effect
- Horizontal
  - + Annotation task
  - + Placing everyday object on it
  - – Neck pain

Combining Horizontal and Vertical Surfaces

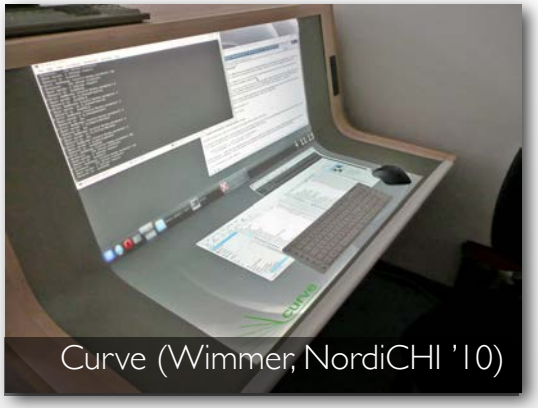
Tilted Tabletop
(Müller-Tomfelde, '08)

ViCat (Chen, Tabletop '06)

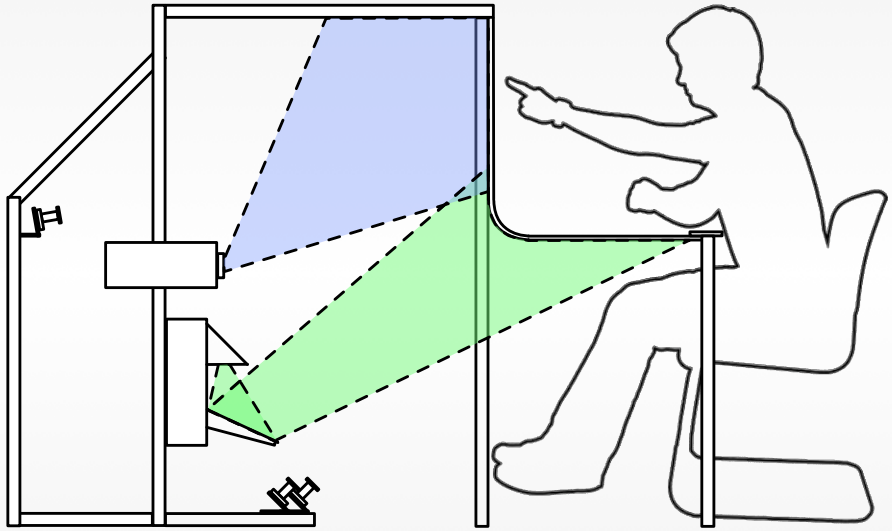
Curved Surfaces

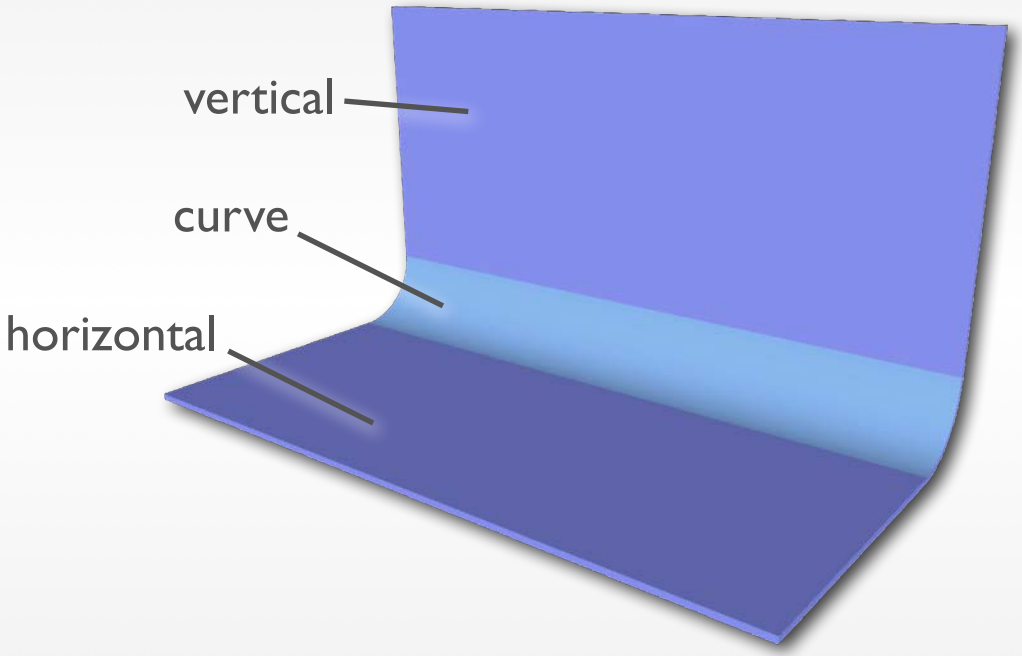

Sun Starfire (Tognazzini, CHI '94)


BendDesk (Weiss , ITS '10)


Curve (Wimmer, NordiCHI '10)

BendDesk System Overview

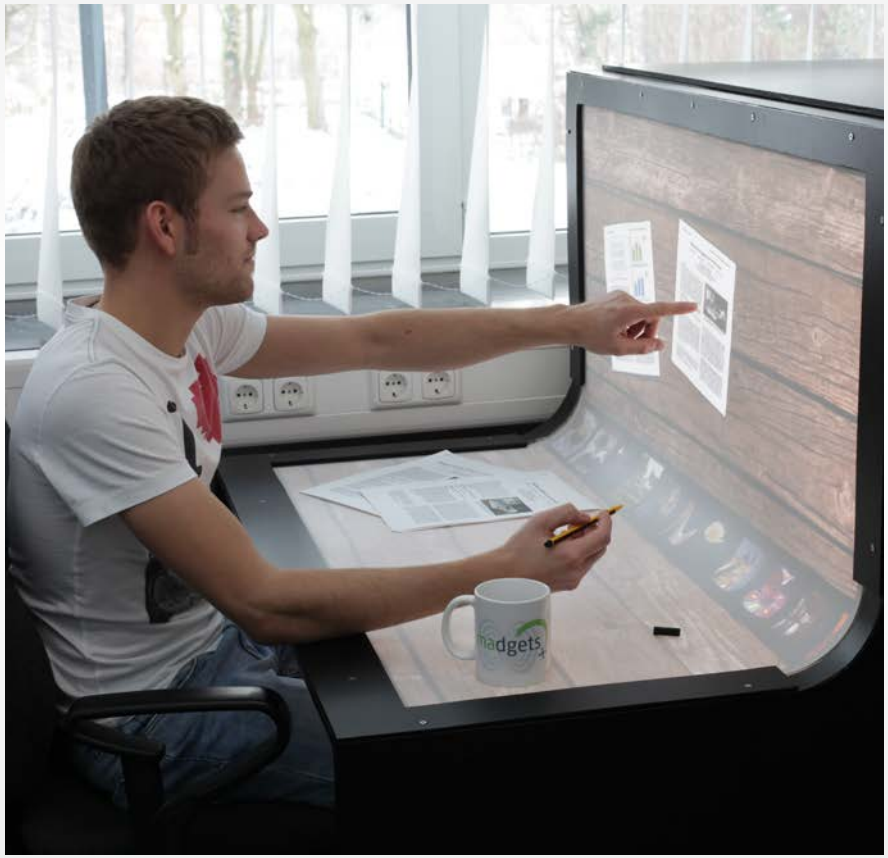


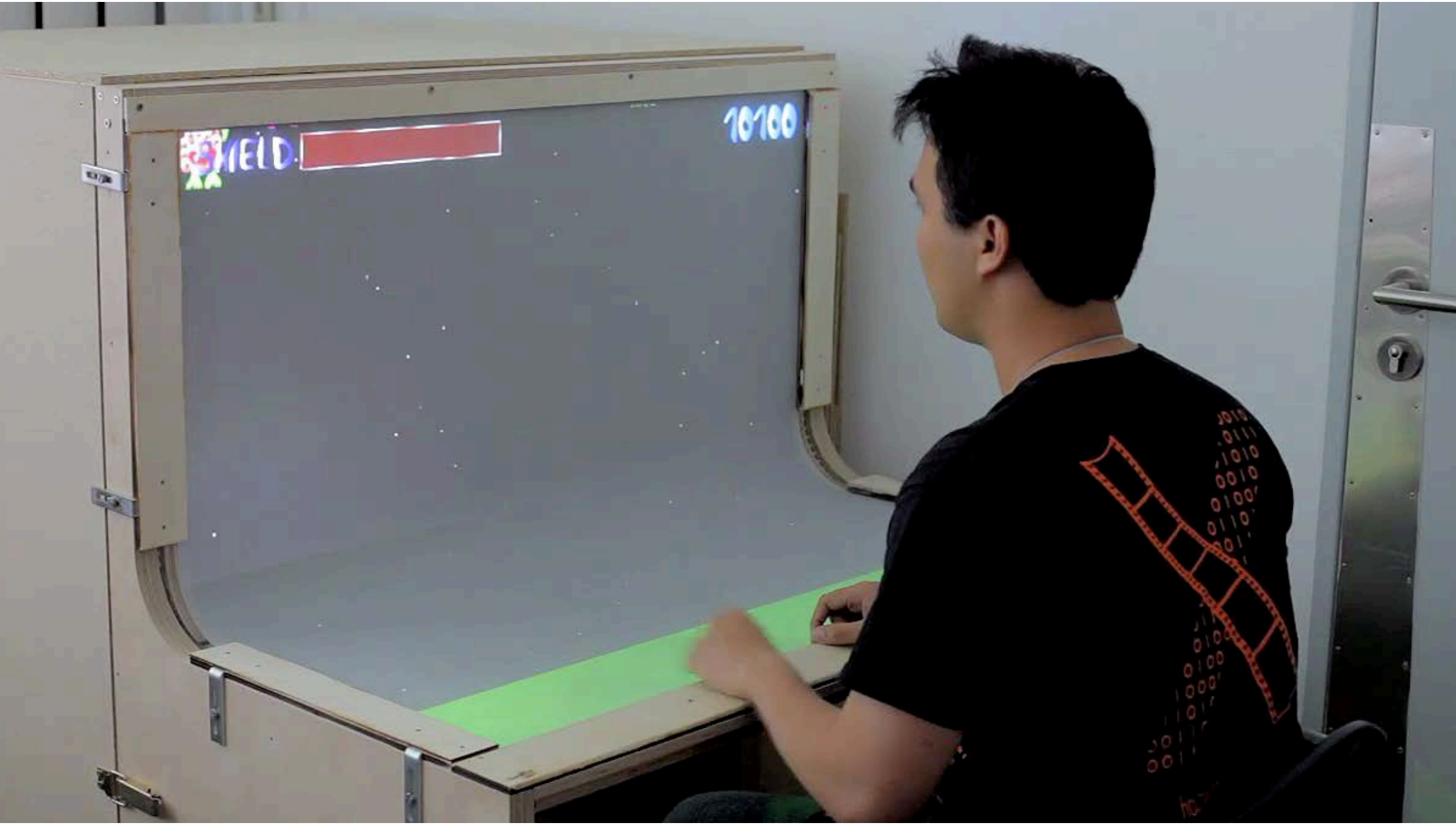


Interaction on Curved Surface

Interaction on Curved Surface

- Curve influences dragging performance
- Body mechanics matter
- Continuous gestures work, but haptic barrier
- Different cognitive mappings between 2D vs. 3D space
- **Vision-based touch screen!**

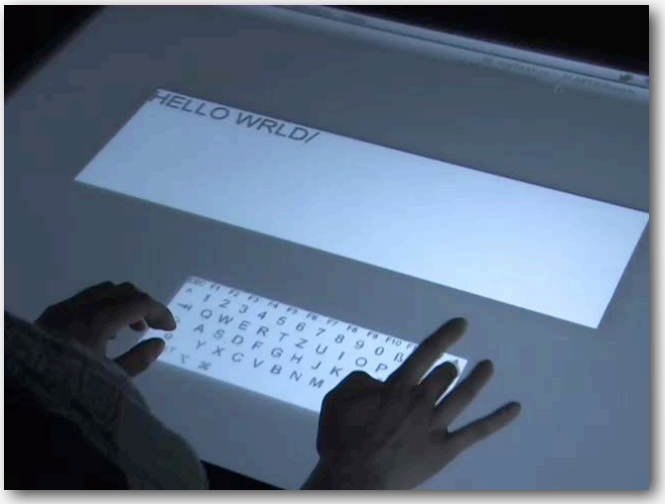


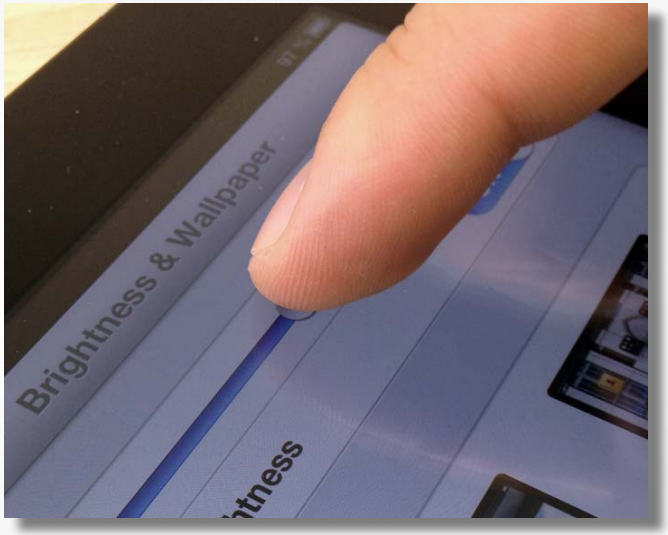

10100

In-class Exercise: Predicting Future

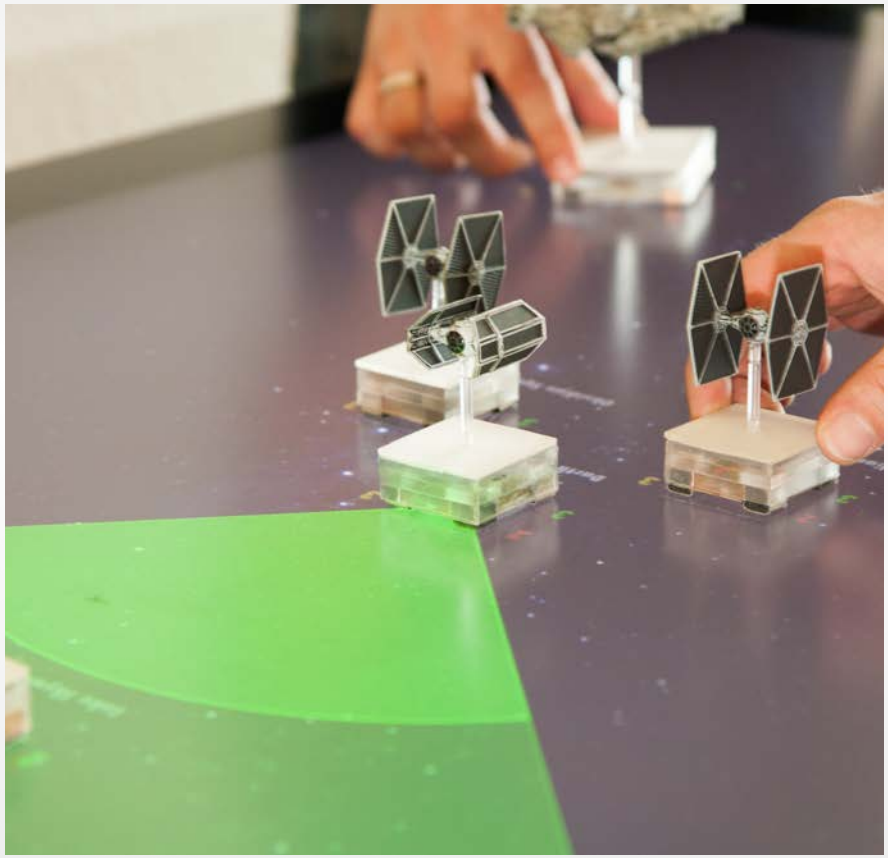
Try to type on your smartphone without looking at the screen.

Limited Haptic Feedback



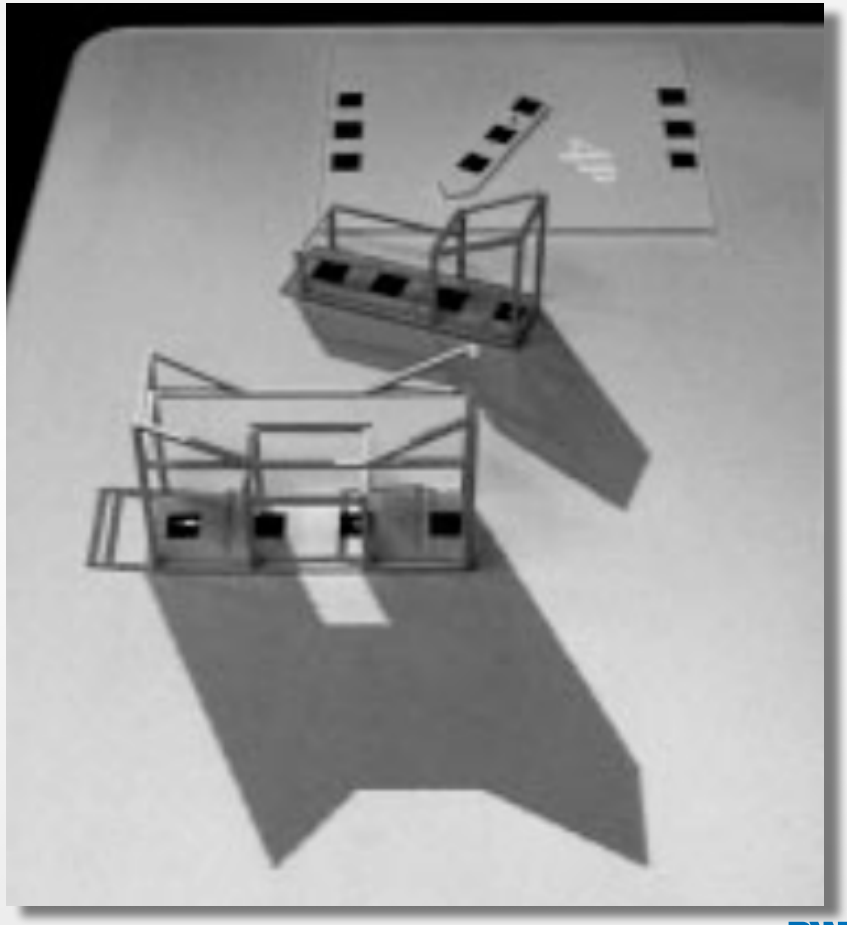


Tangibles on Interactive Surfaces



Tangible User Interfaces

- **Urp** Underkoffler, Ishii CHI' 99
  - Urban planing simulator

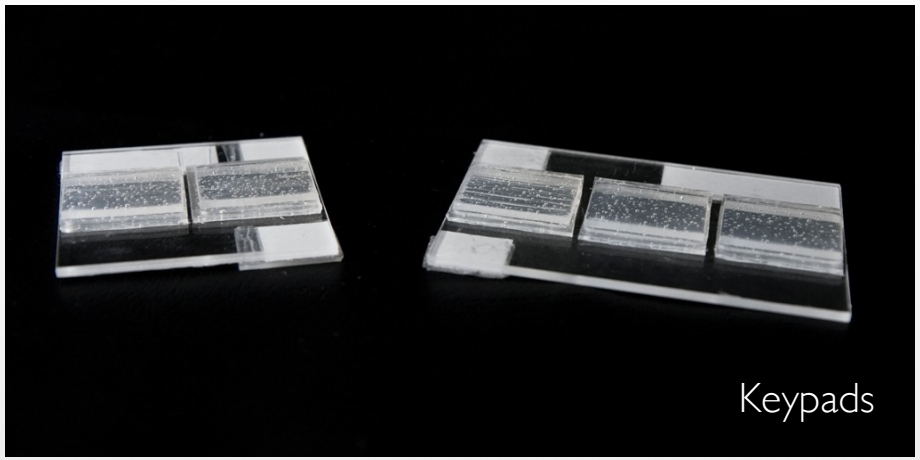


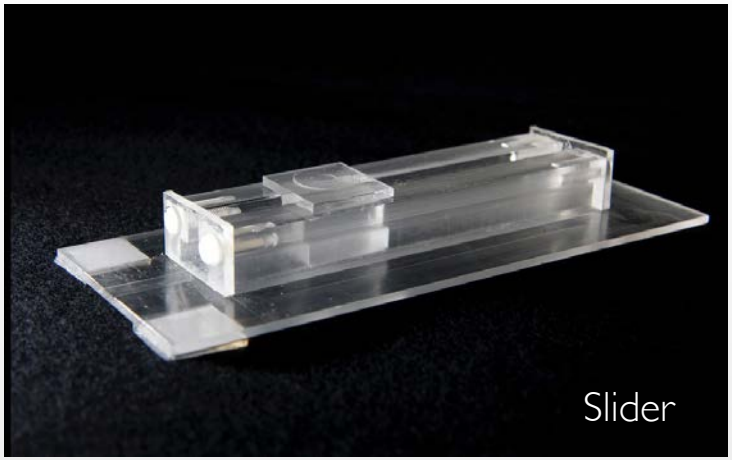
Tangible User Interfaces

reacTable Jordà et al. TEI' 0

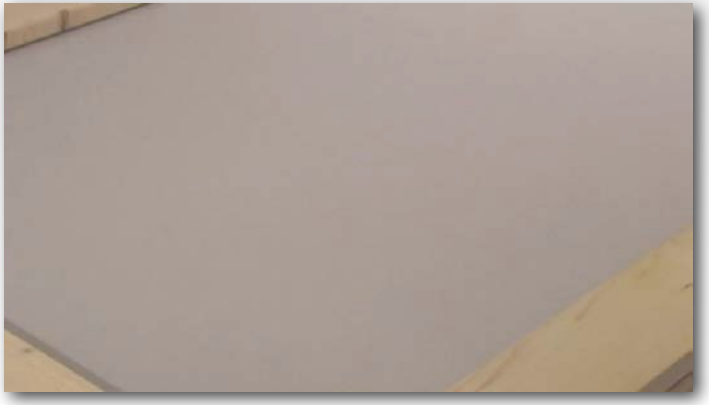
SLAP Widgets

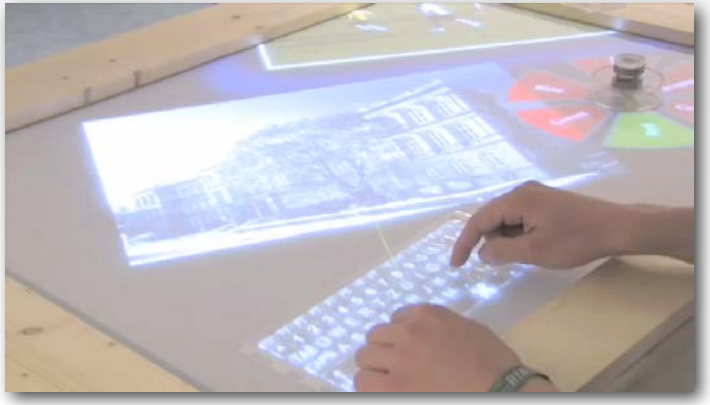
[Weiss et al. CHI '09]





SLAP Keyboard



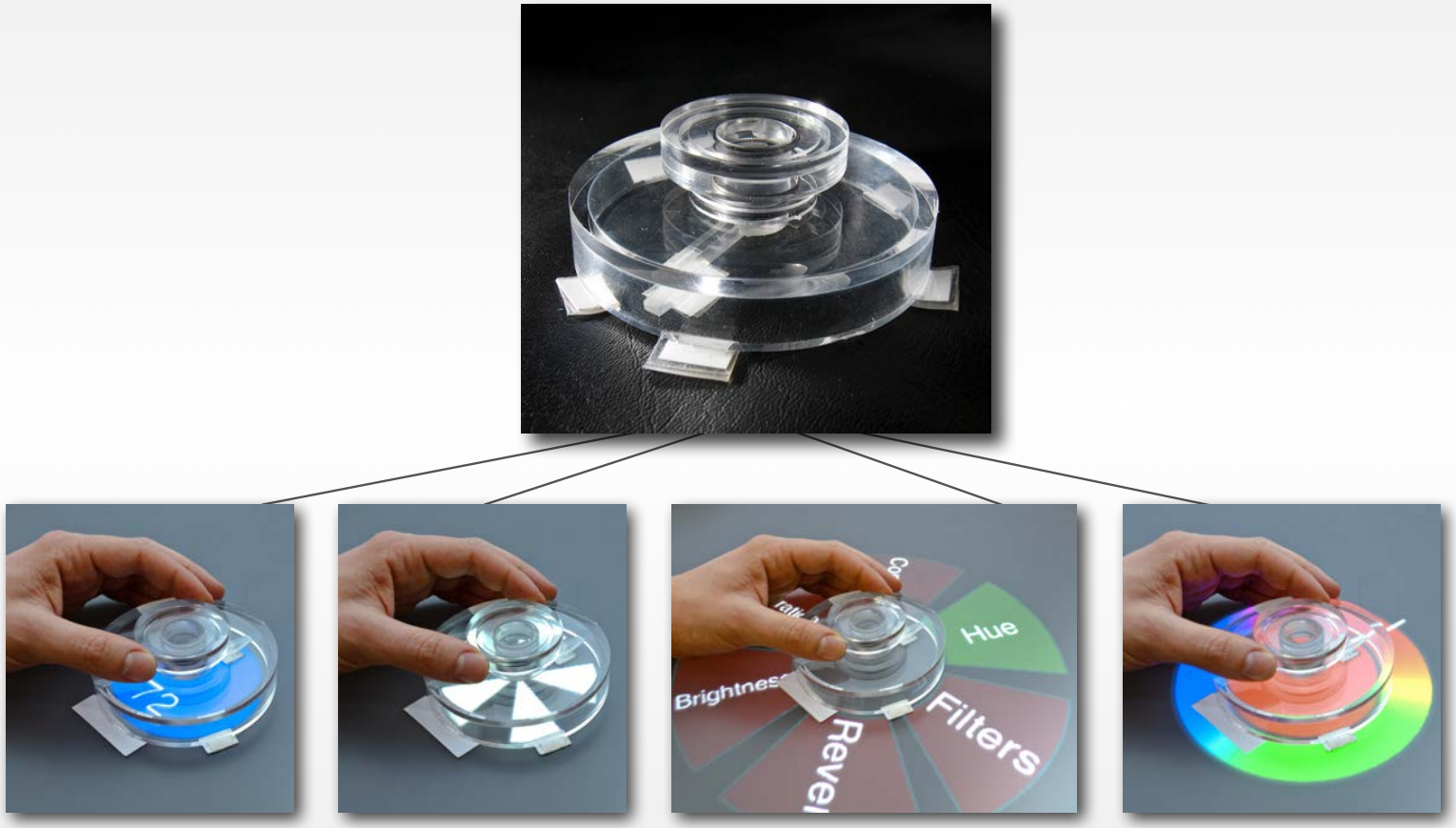


SLAP Knob

jog wheel mode

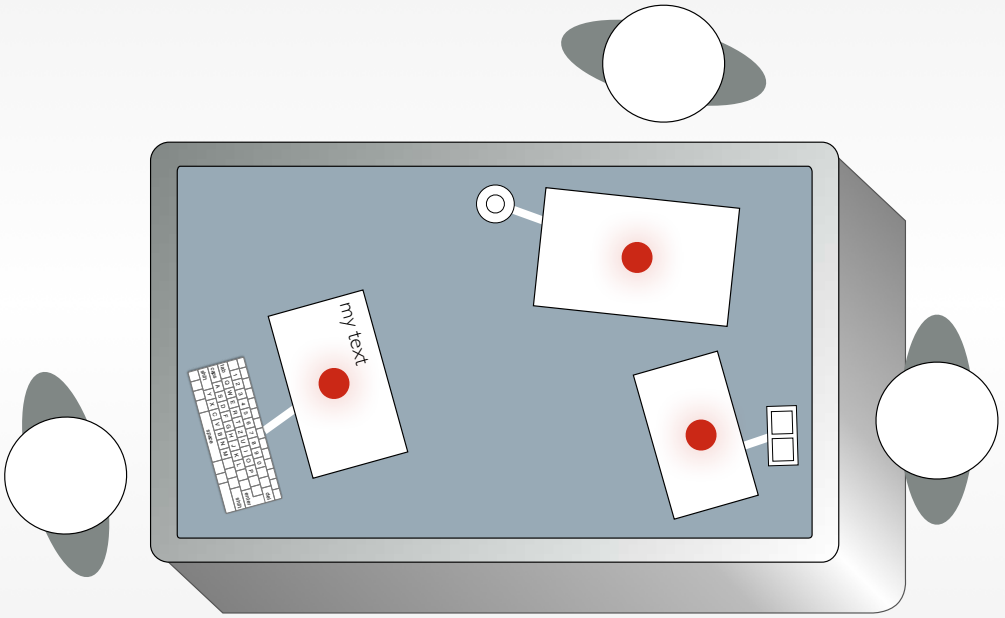
menu/value mode

SLAP Knob

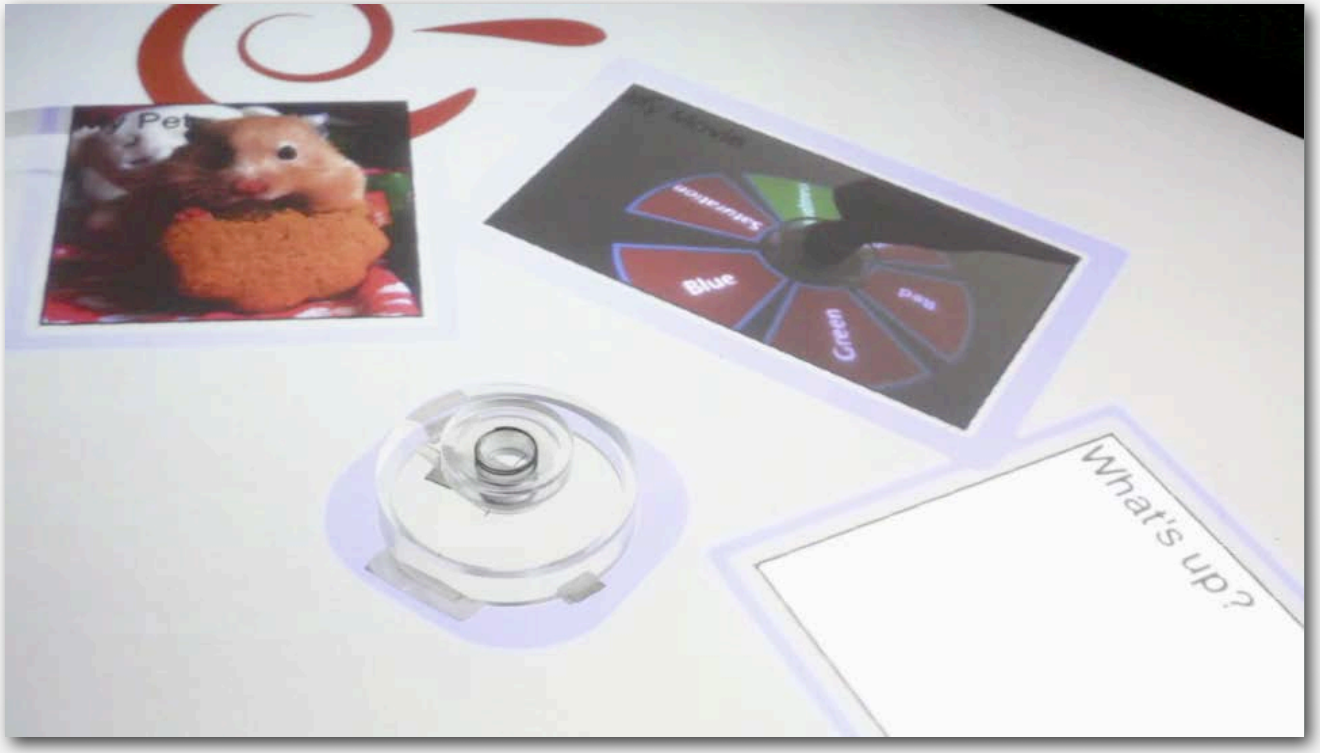


value jog wheel menu hue

Multi-Focus Policy



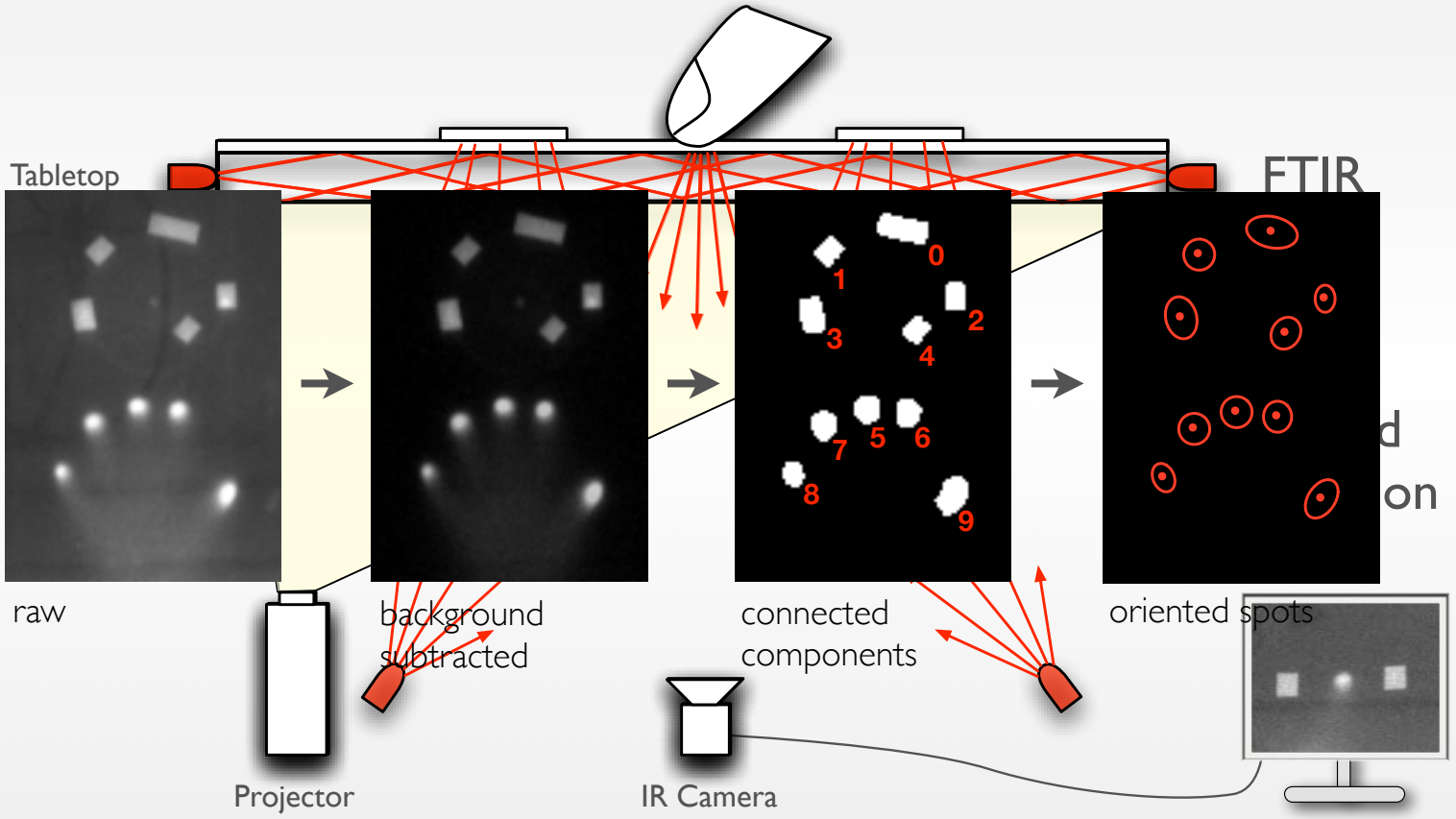
Pairing



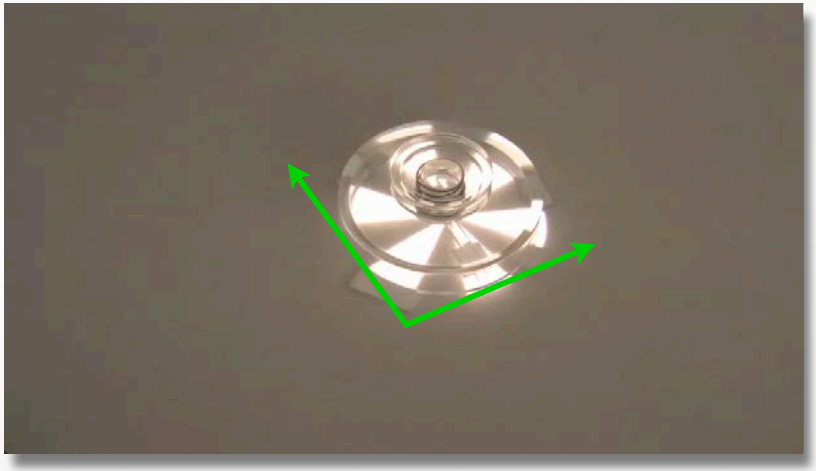
Pairing


Bridging the Gap Between Virtual and
Physical Controls on Tabletops

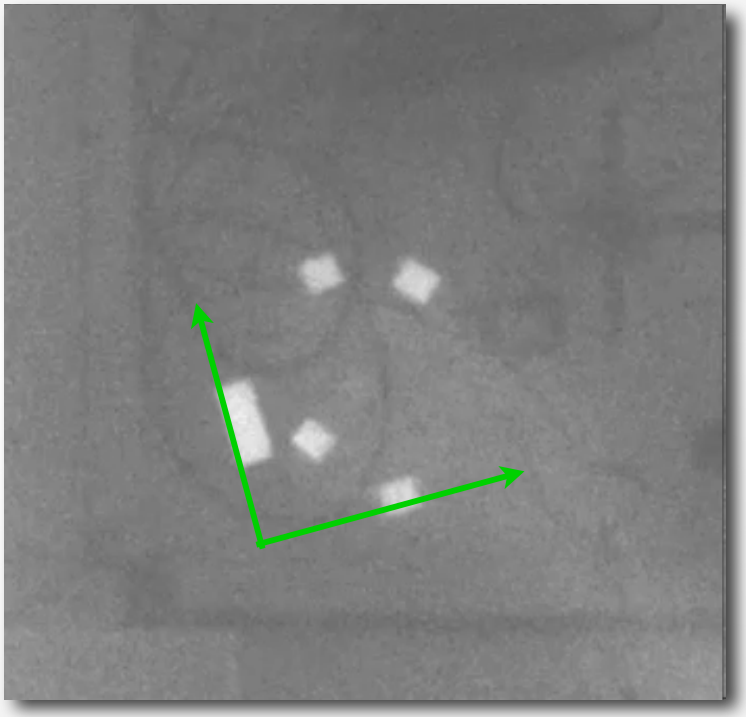
Multi-Touch Table



Widget Detection



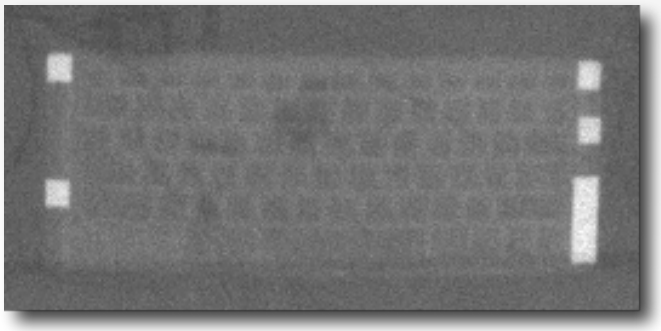
Tabletop view



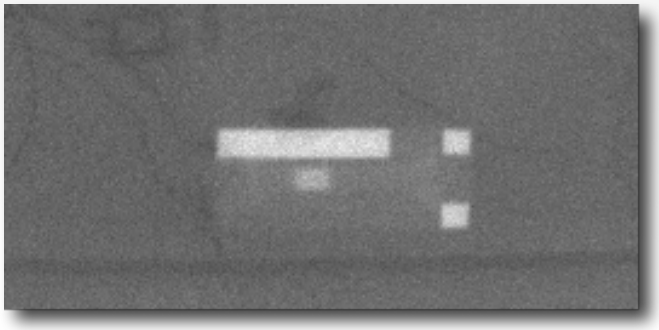
IR camera view
(640x480, 120fps)

Widget Detection

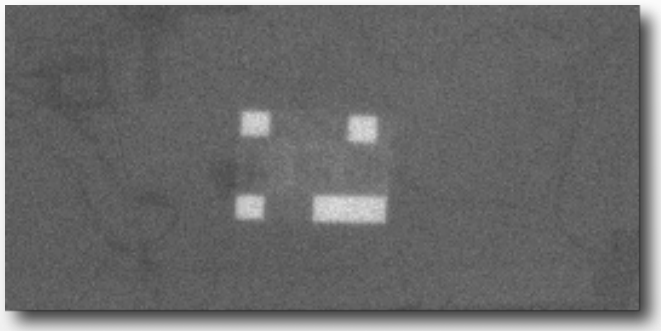
Keyboard



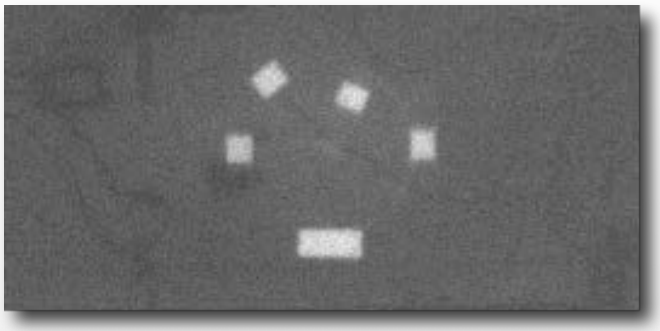
Slider



Keypad



Knob



The eLabBench

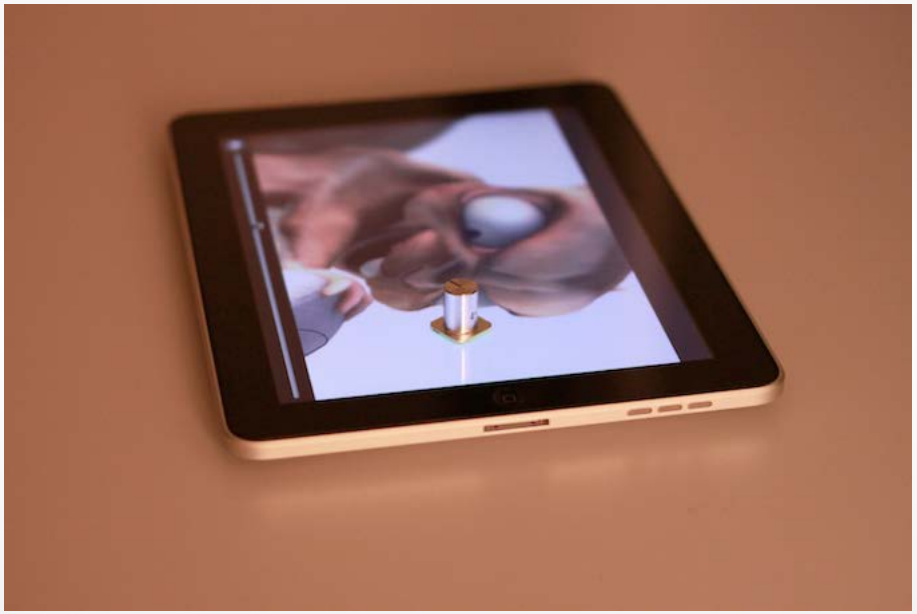
[Tabard et al. ITS '11]

The eLabBench

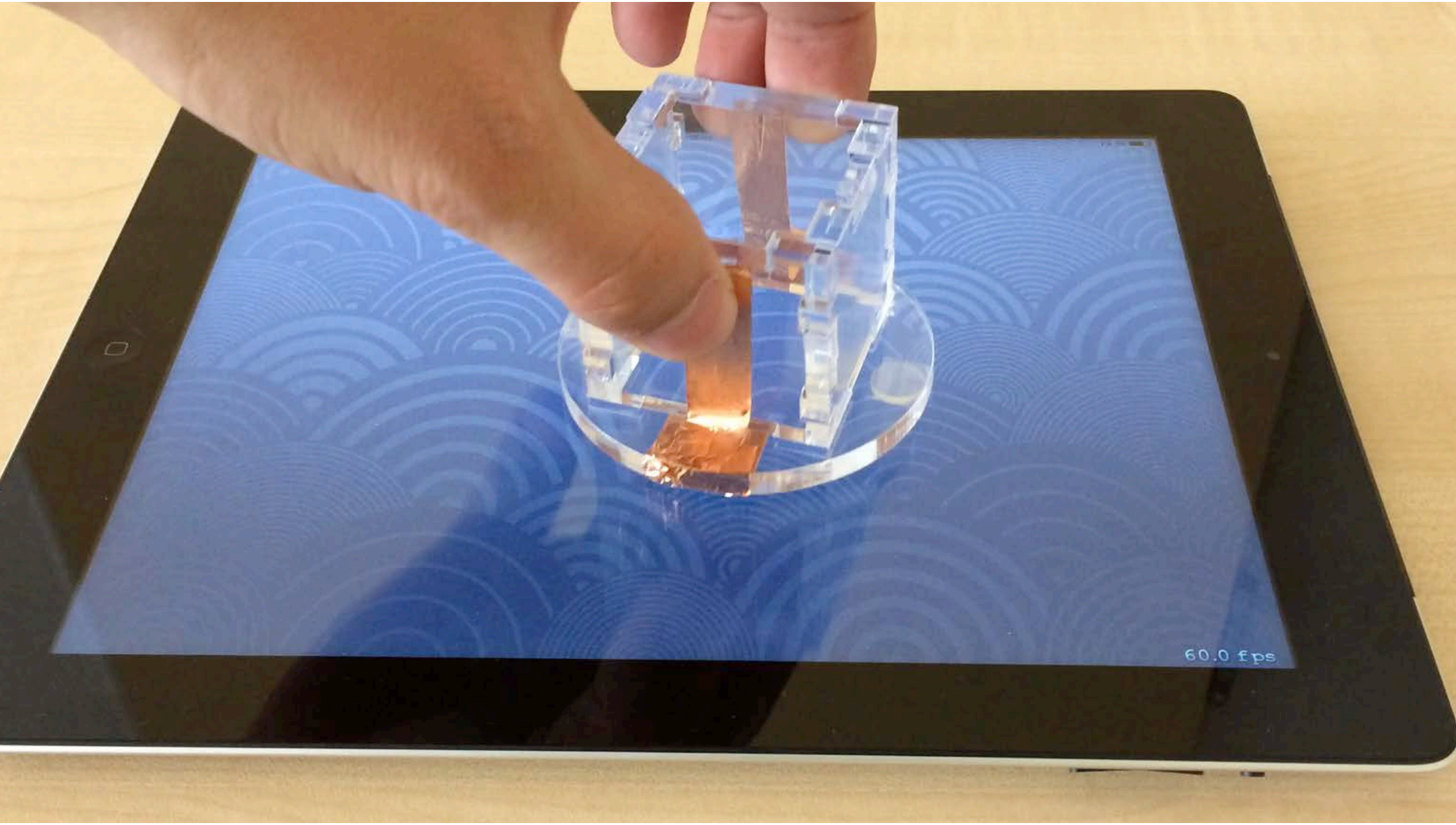
[Tabard et al. ITS '11]

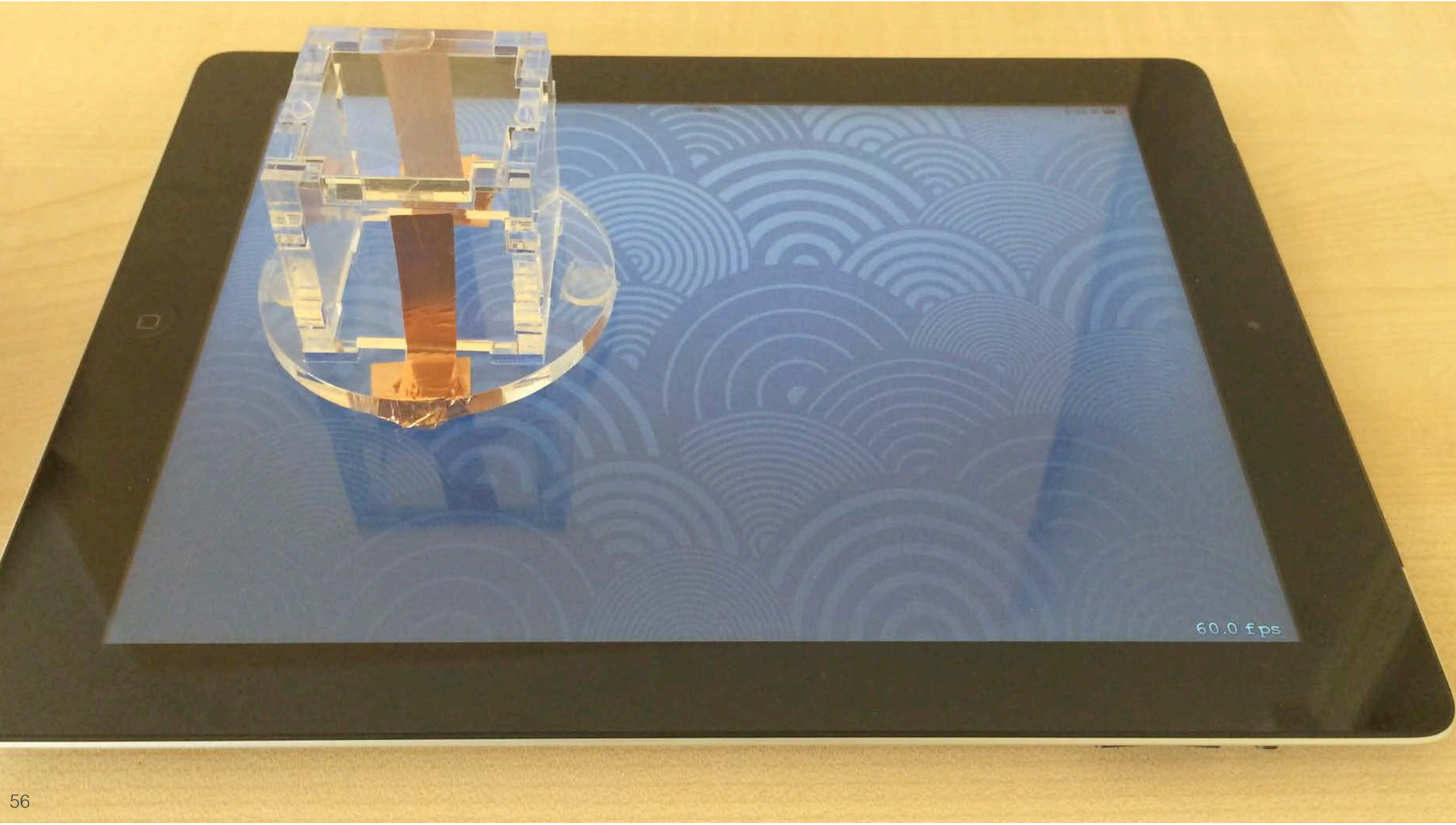
Tangibles on Capacitive Touch Screens

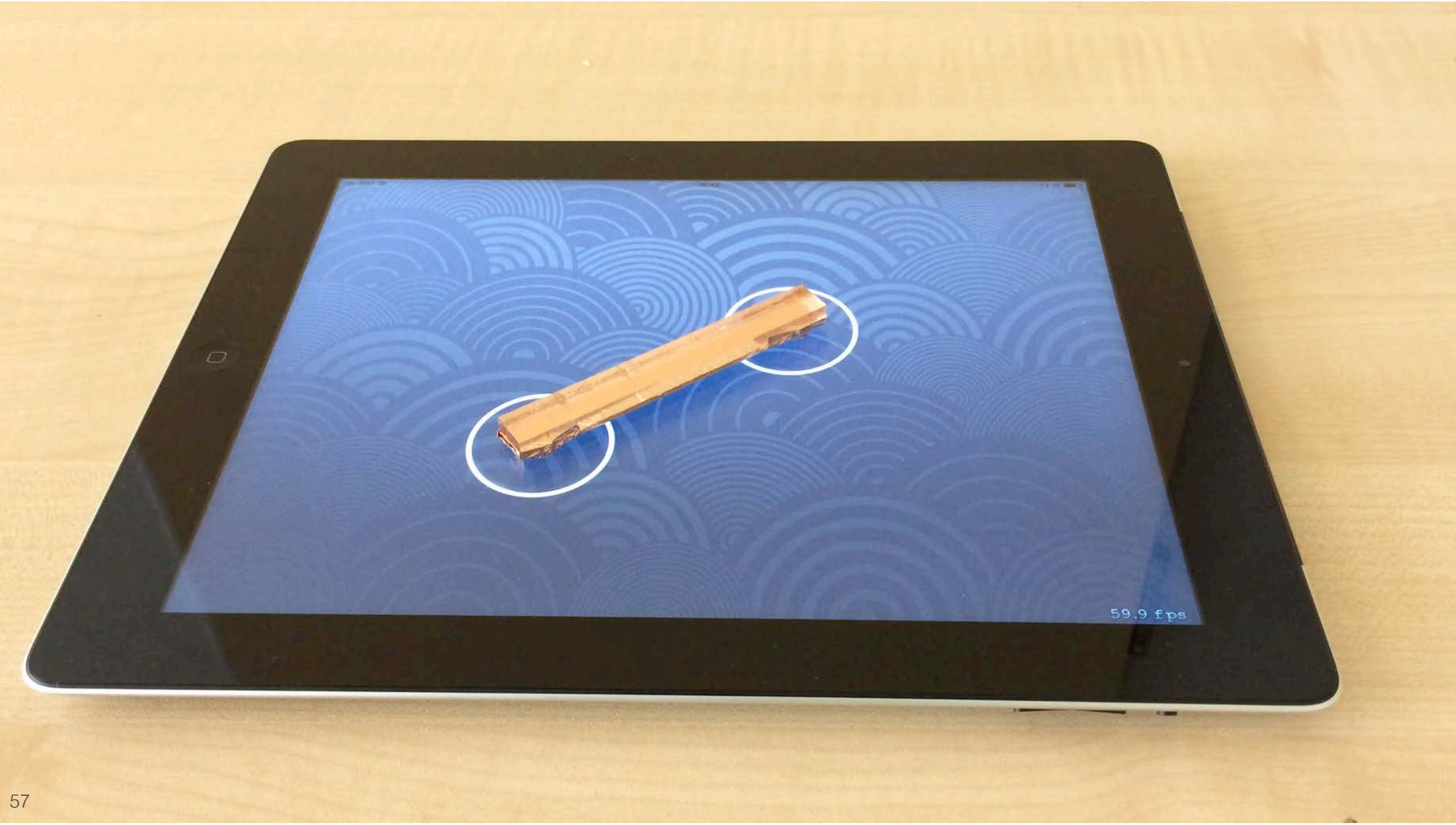
Capstones [Chan et al. CHI 2012]

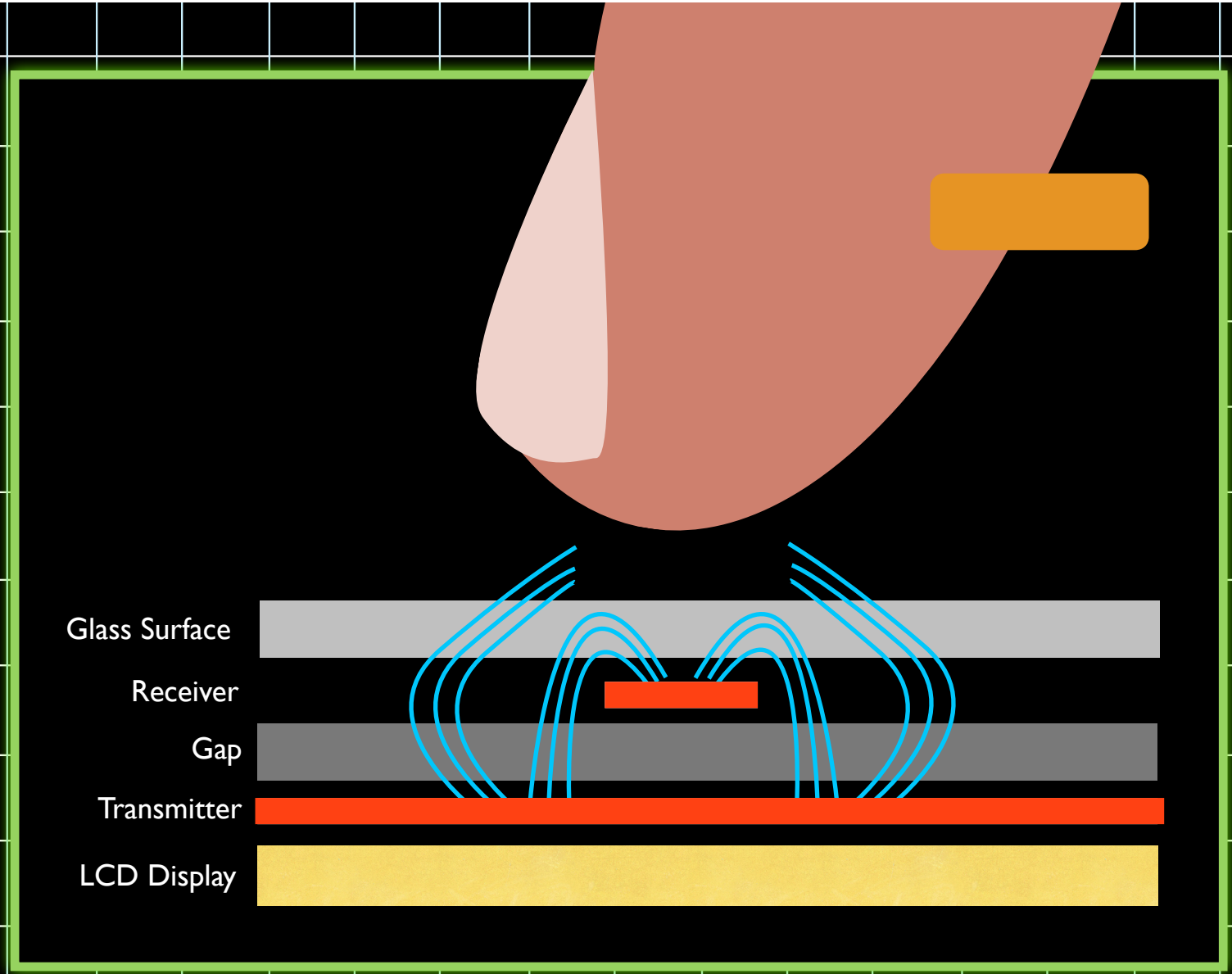


CapWidgets [Kratz et al. CHI 2011]


60.0 fps


60.0 fps


59.9 fps


Glass Surface
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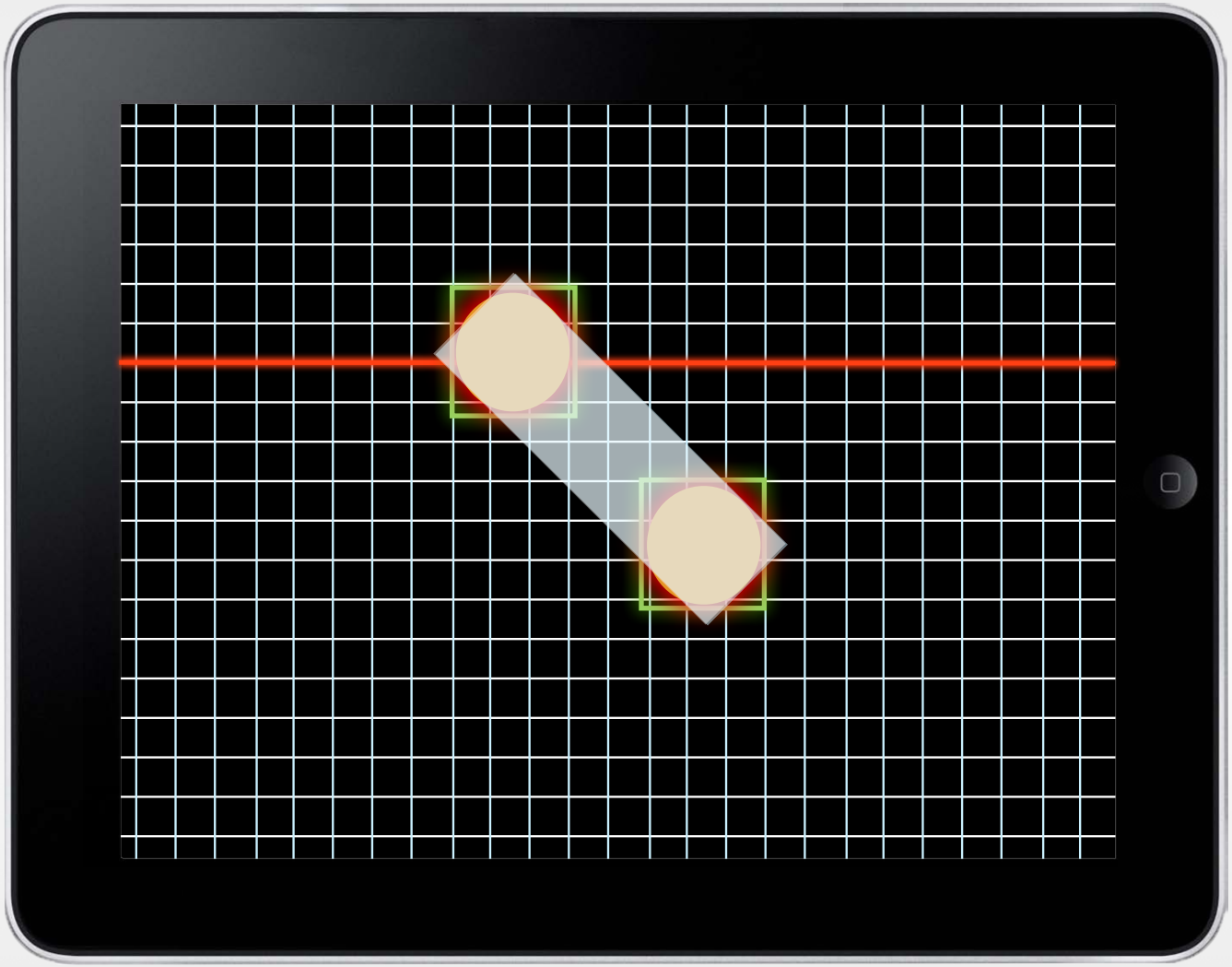
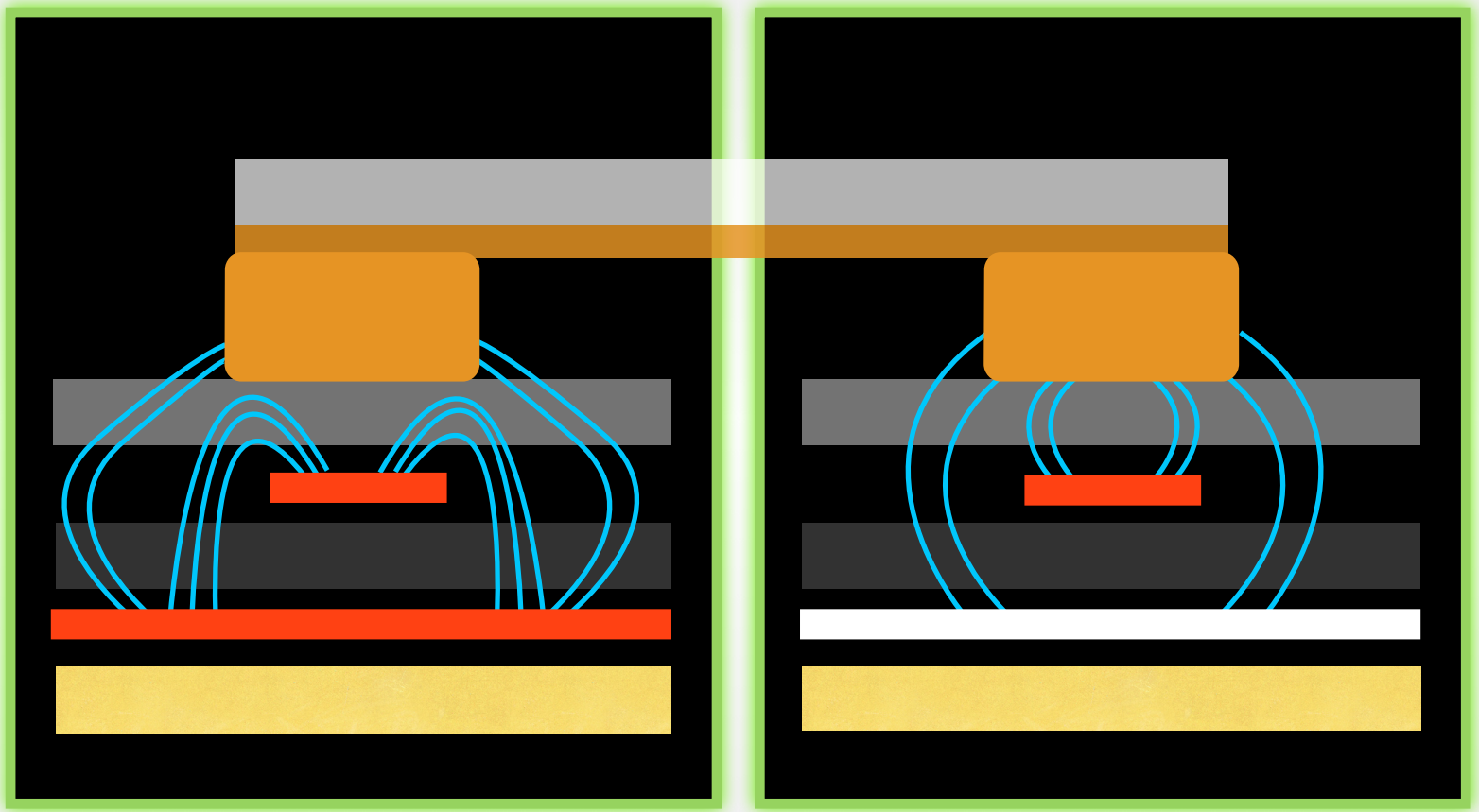
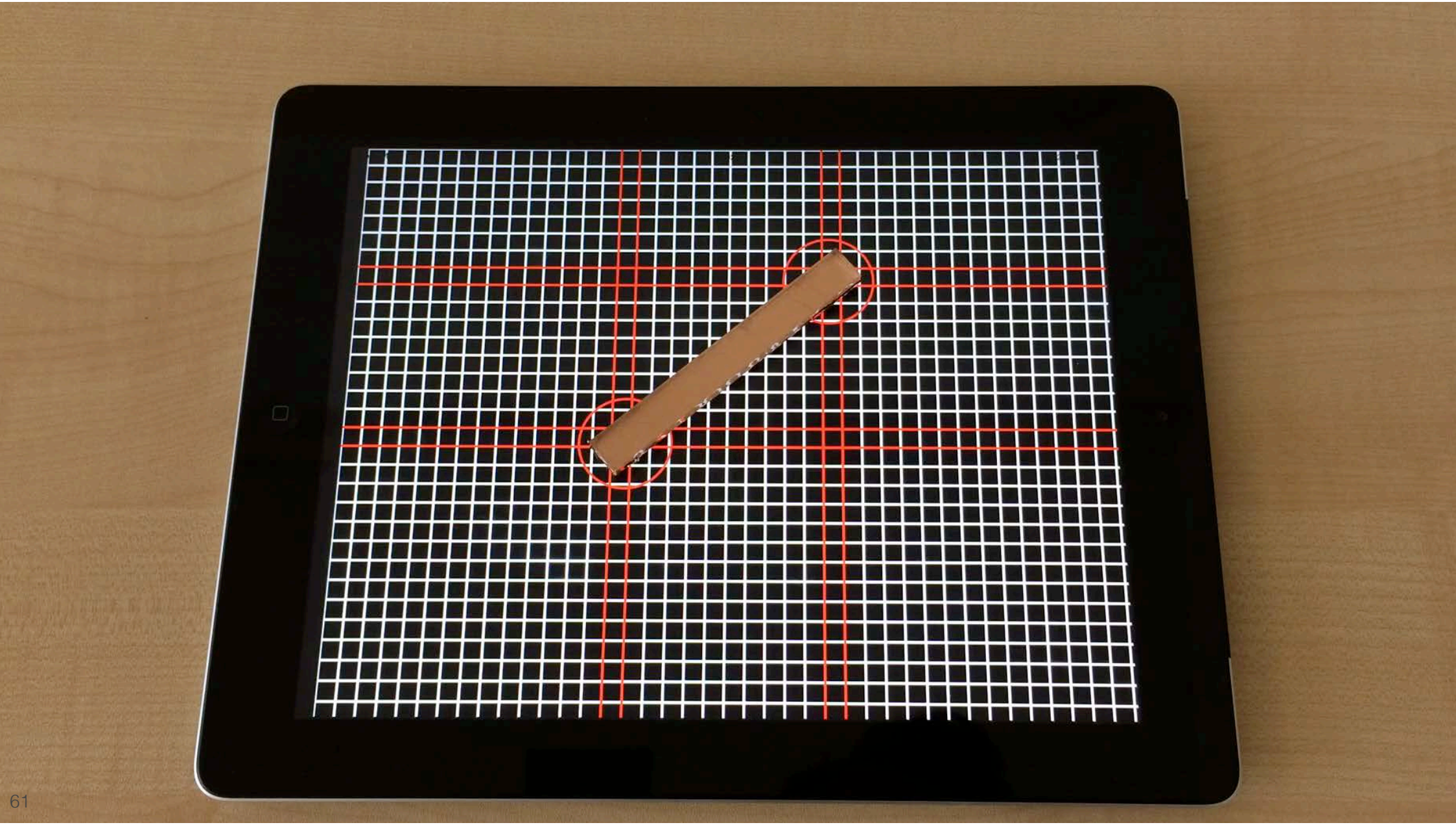
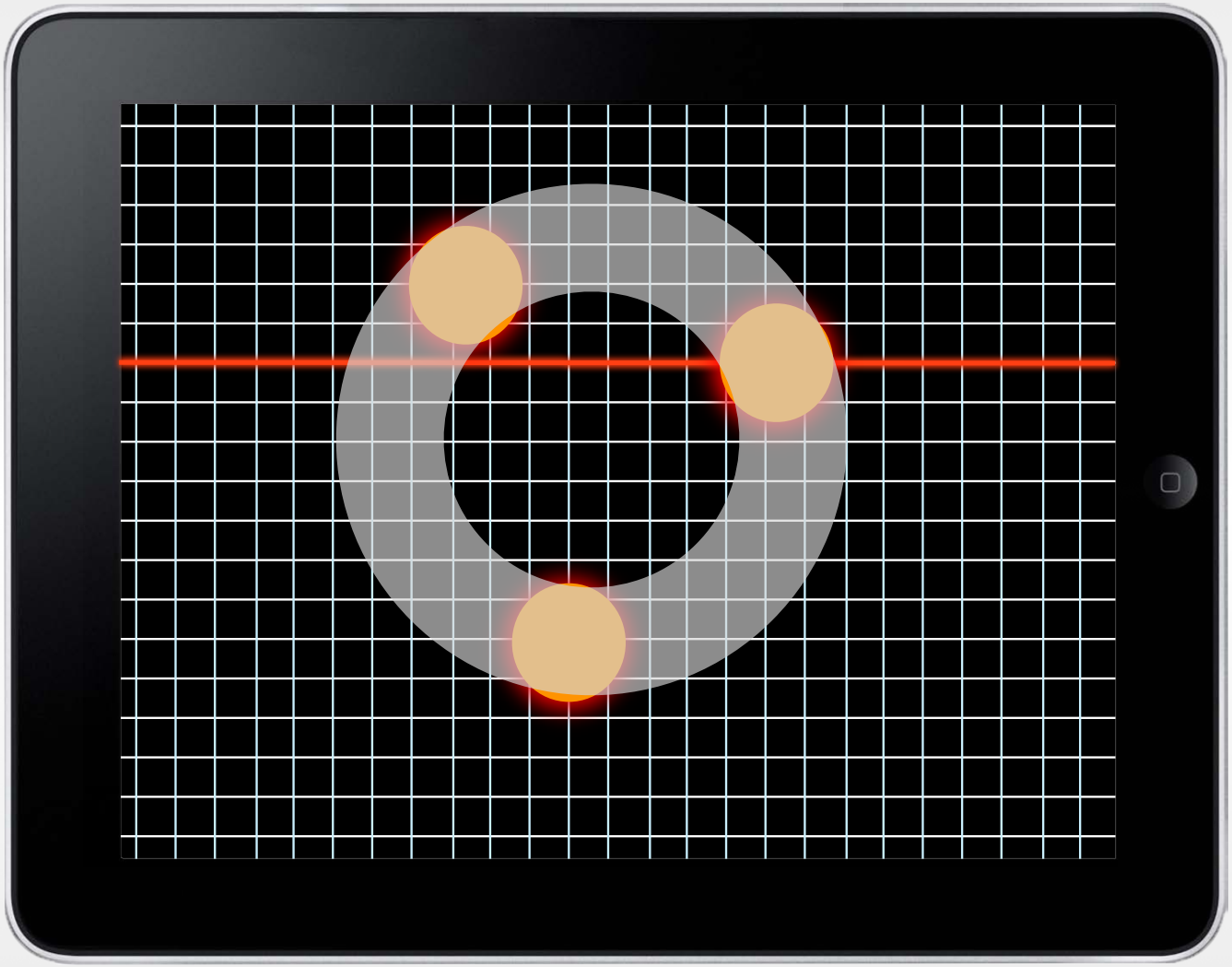
LCD Display









Summary

- Technologies
- Multi-touch Workspaces
- Tangibles
  - On optical systems
  - On Capacitive systems