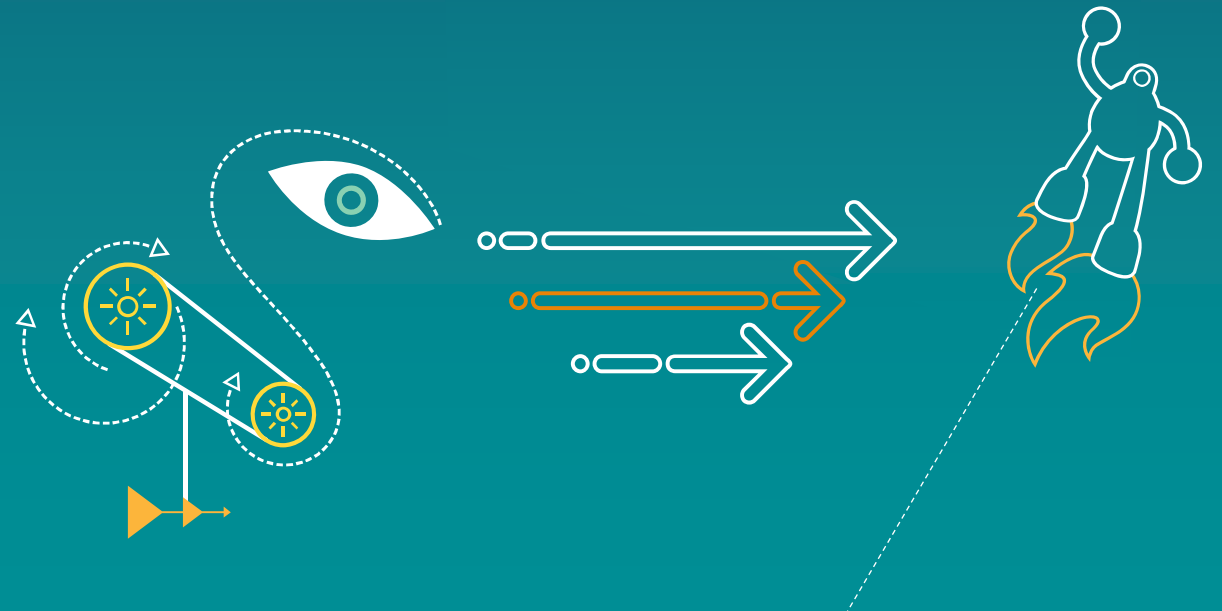


John M. Wyrwas, Hae-Jong Seo, Russ Gruhlke
Qualcomm Technologies, Inc., July 27th, 2015

Interacting with Displays in 3D



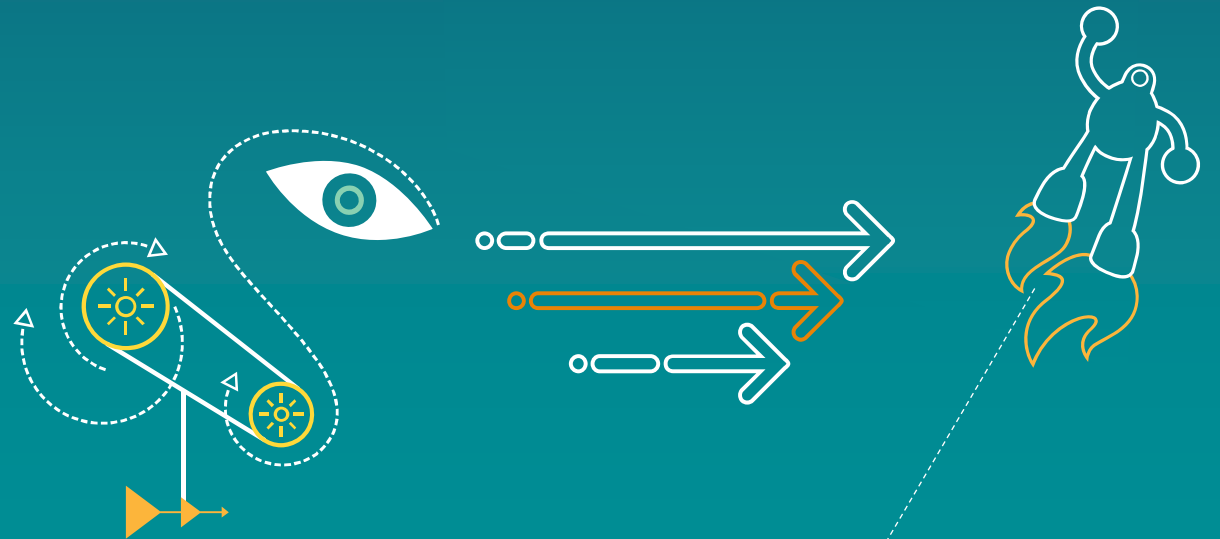
Russ Gruhlke, Babak Aryan, John Wyrwas, Hae-Jong
Seo, Ying Zhou, Khurshid Alam, Evgeni Gousev



Russ Gruhlke

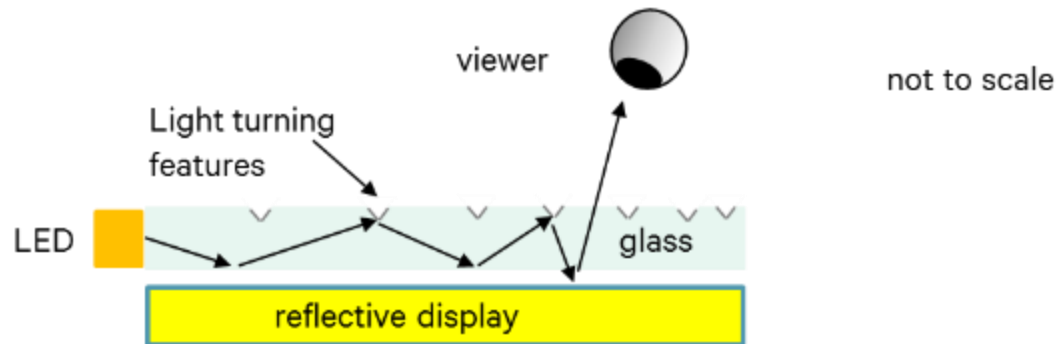
Qualcomm Technologies, Inc., July 27th, 2015

Project history and overview

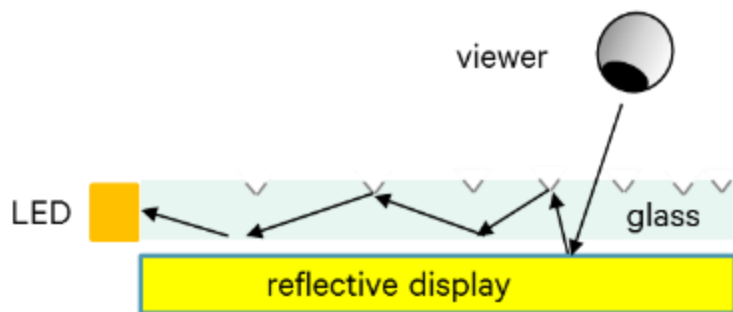


Intro: 3D UI Origins

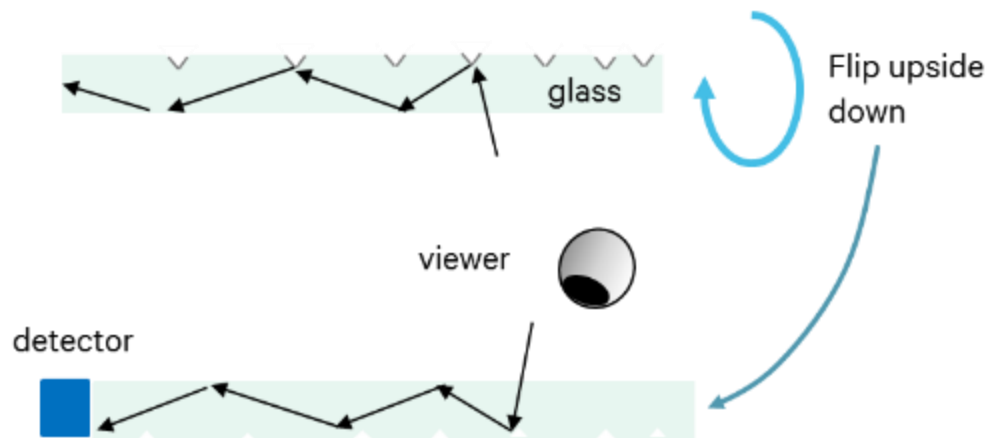
Front Light



Reciprocity



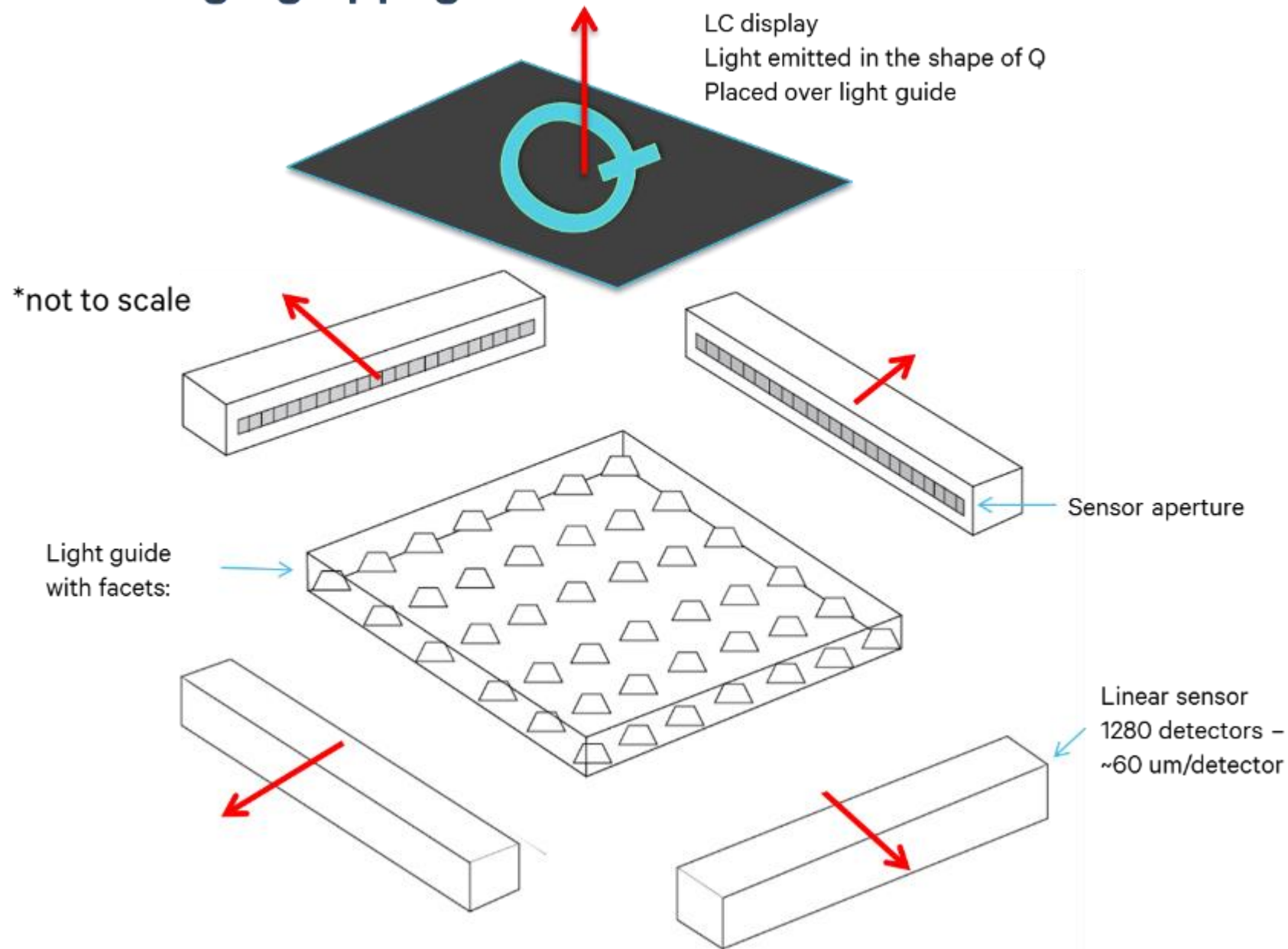
Qualcomm
3D UI



Key features

- Peripheral sensors
- Light guide
- Turning features

Intro: imaging appl geom



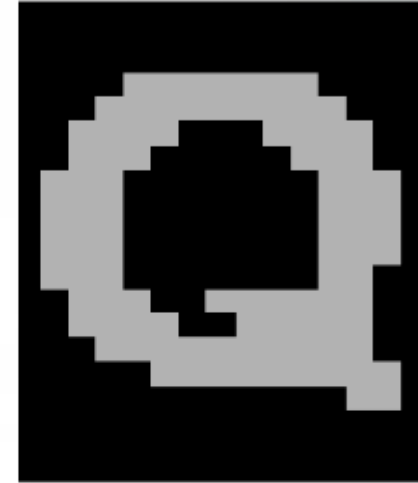
Intro: imaging appl results

▶ What we did

- Proof of concept demonstration of lensless imaging of an object in close proximity to the light guide

Low resolution object
15x20 pixels

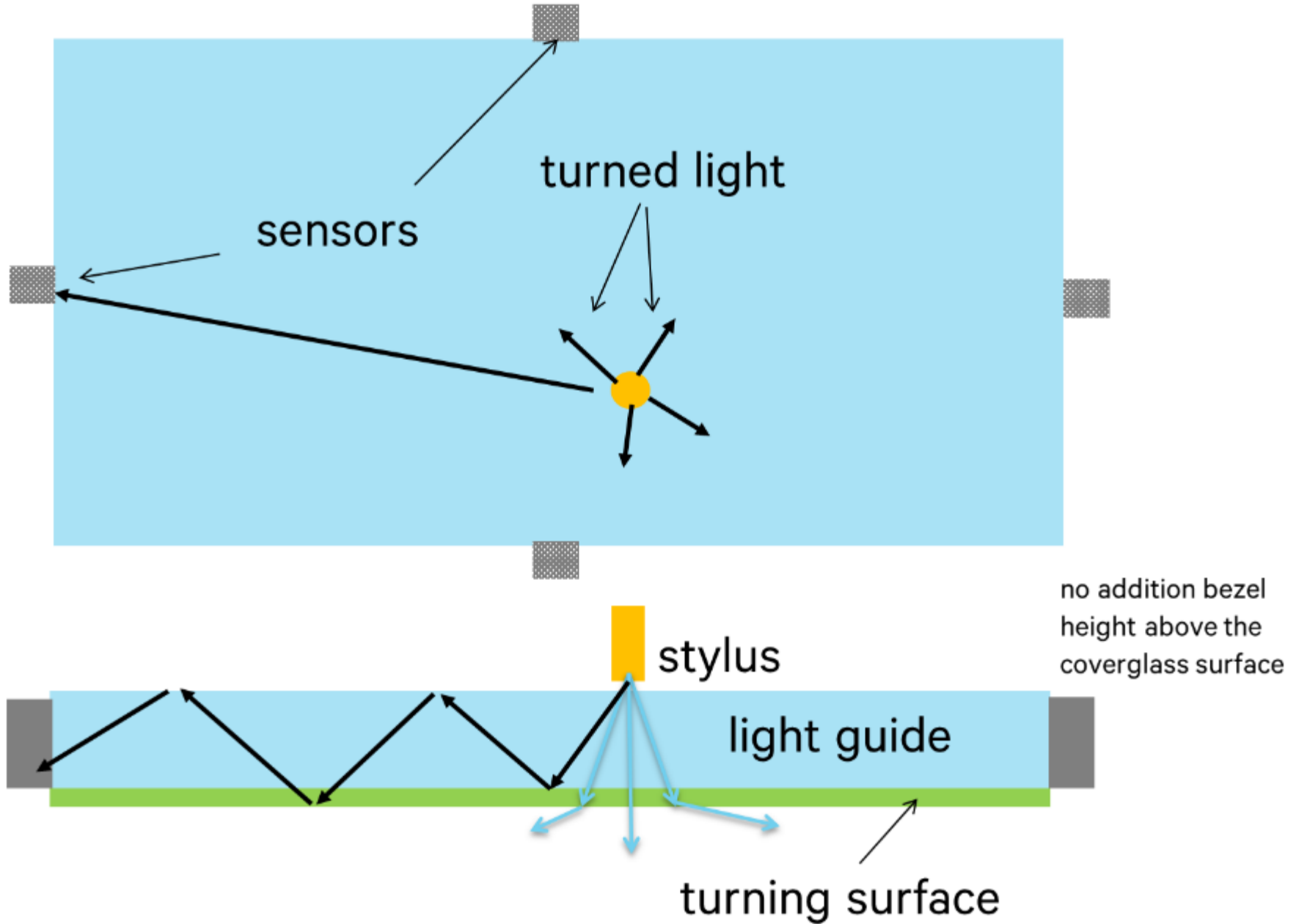
Original Image



Reconstructed Image



Intro: stylus appl geom



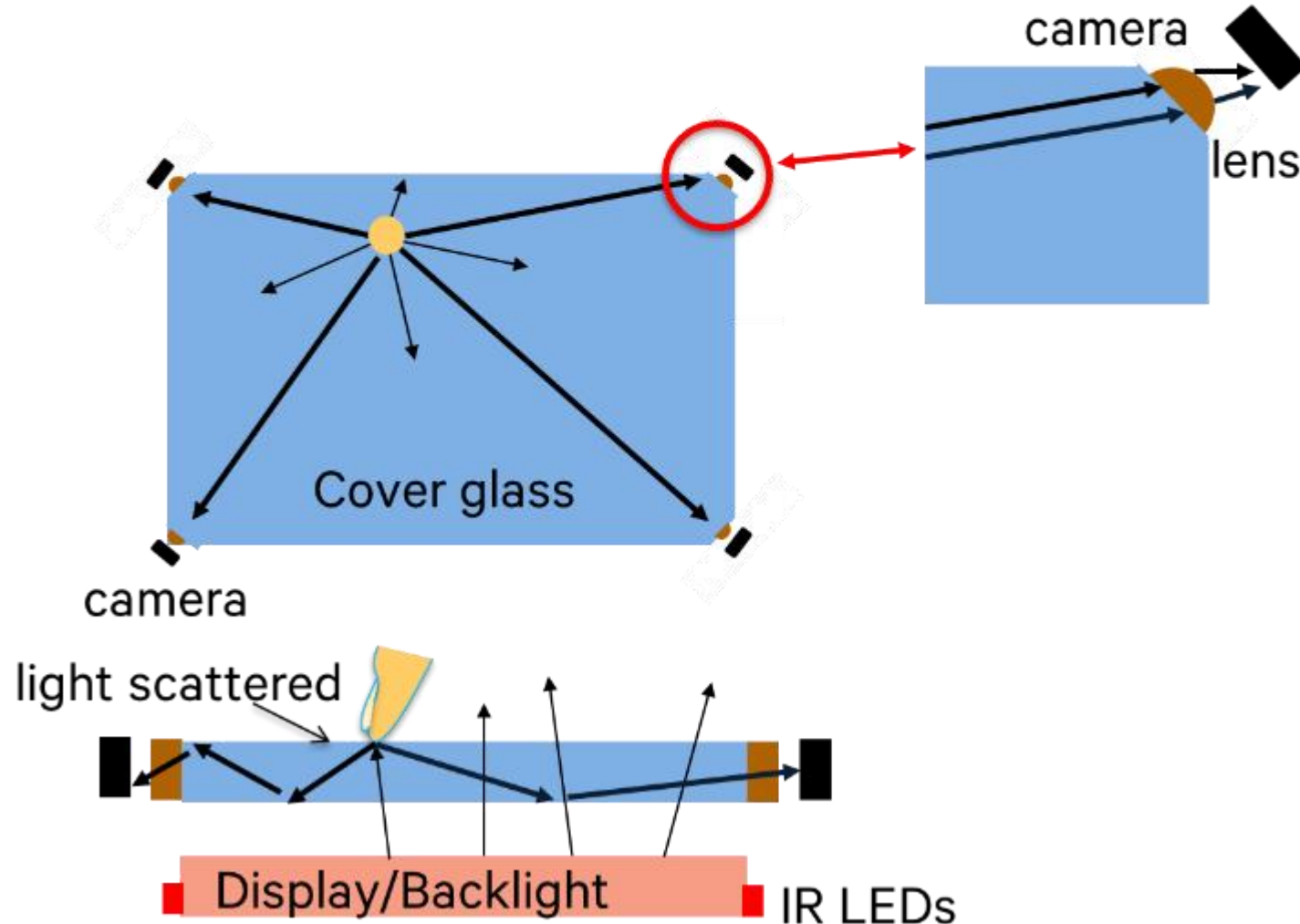
Intro: stylus appl results

Features

- Low cost touch
- Scales well to large area
- Can be put into cover glass/add on
- Optical



Intro: touch geom



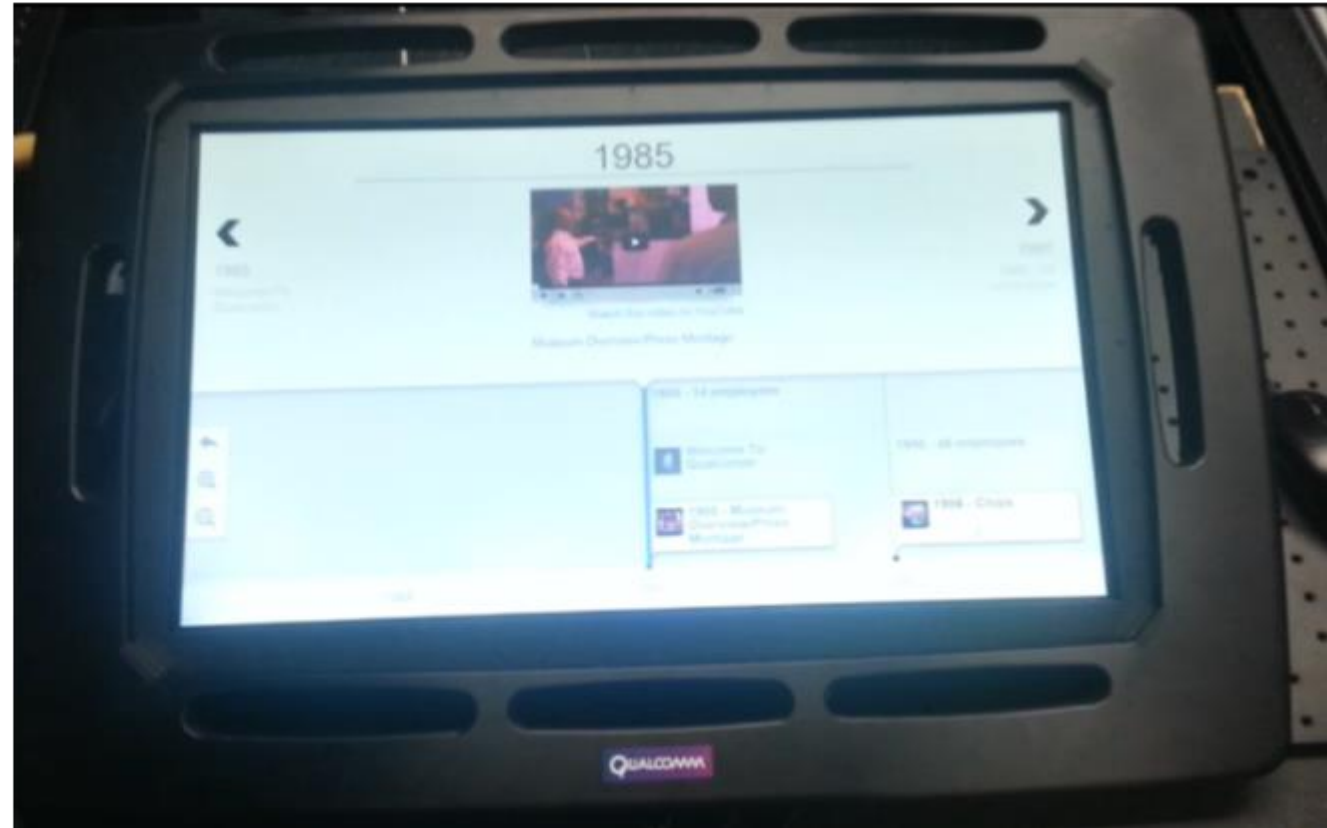
Intro: touch results - see demo

Features

- Low cost touch
- Active/passive stylus
- Scales well to large area
- Can be put into cover glass
- No additional bezel height above cover glass
- Easy to tile

Demo characteristics

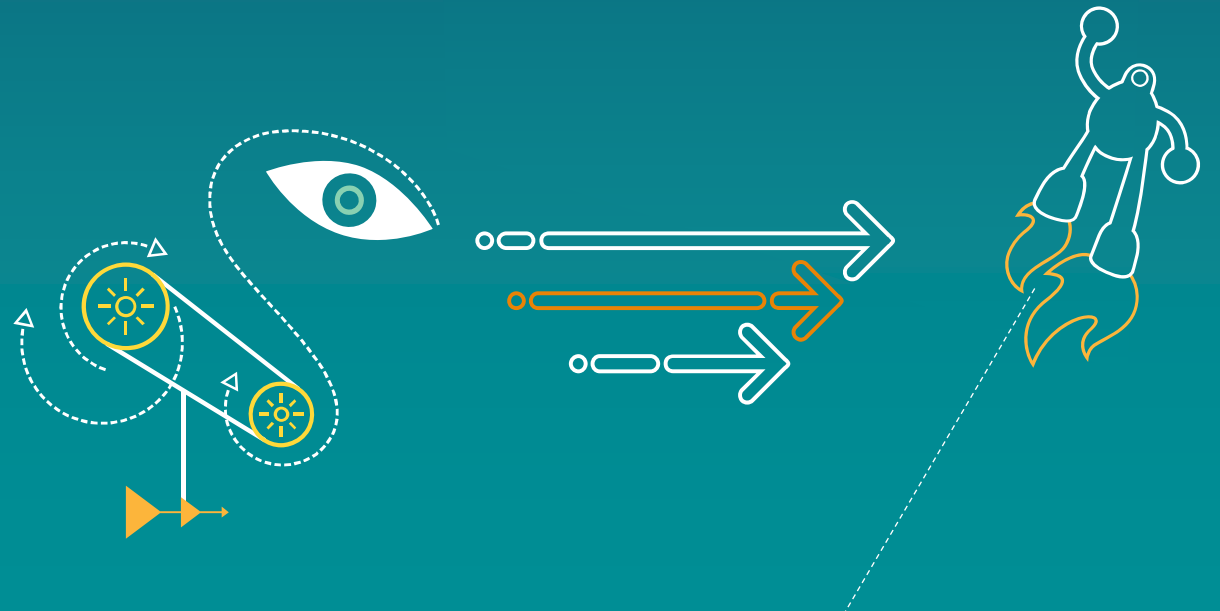
- 24" diagonal
- LCD underneath



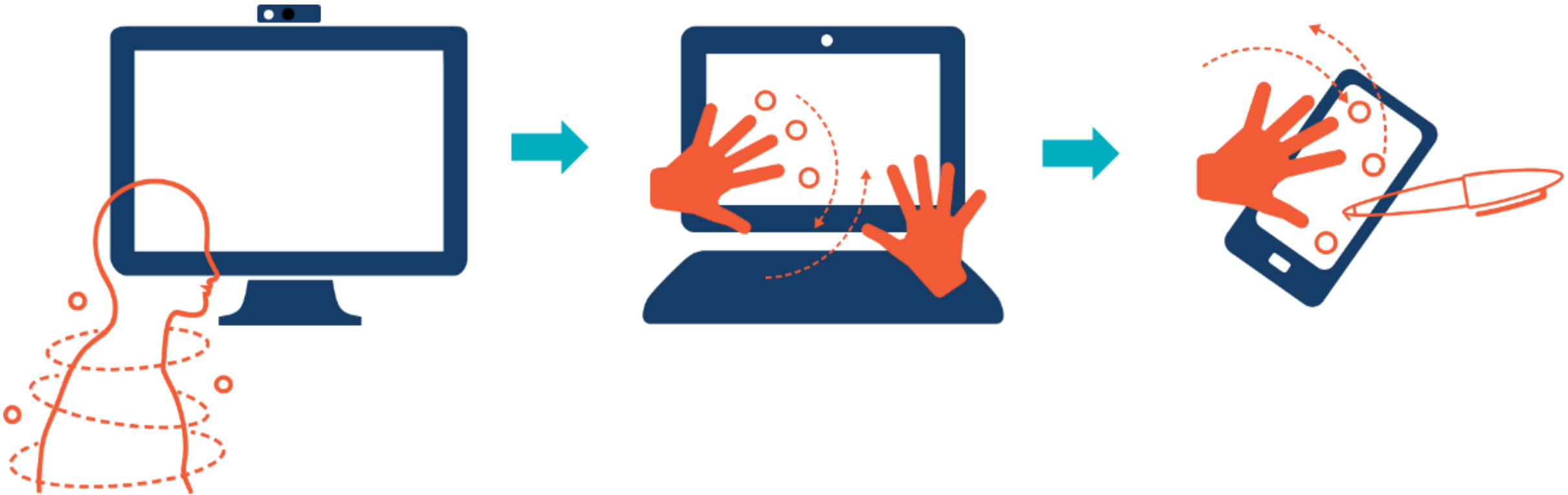
John Wyrwas

Qualcomm Technologies, Inc., July 27th, 2015

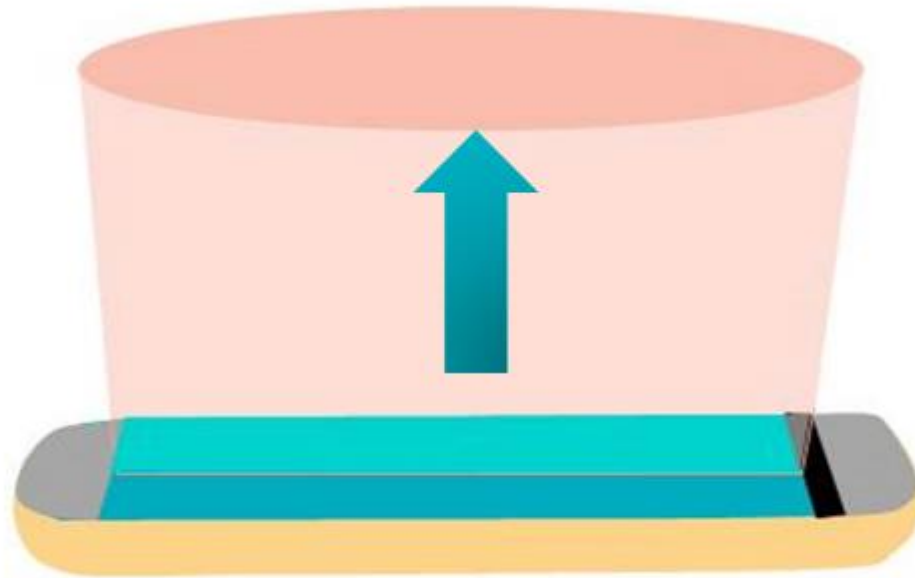
A Novel Three-Dimensional User Interface Technology



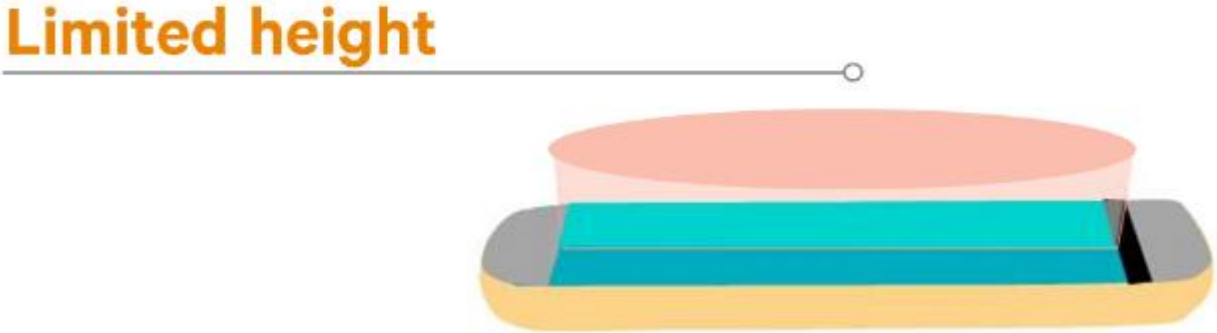
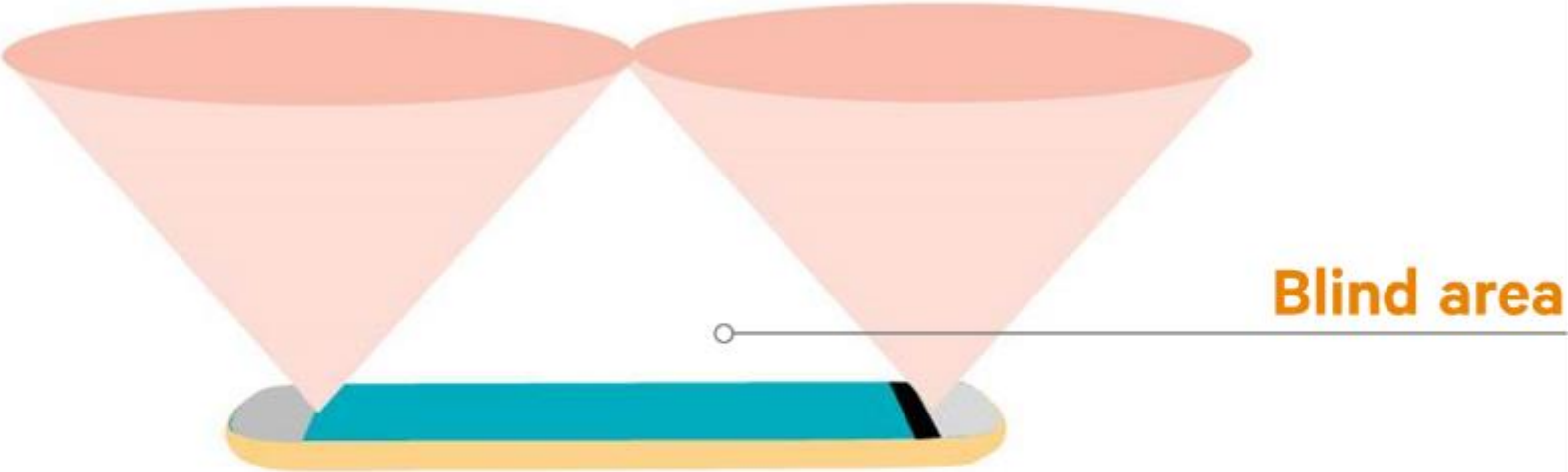
Let's enable complex, multimodal interactions with mobile displays.



Can we extend the richness of multi-touch to 3 dimensions?



Can we extend the richness of multi-touch to 3 dimensions?

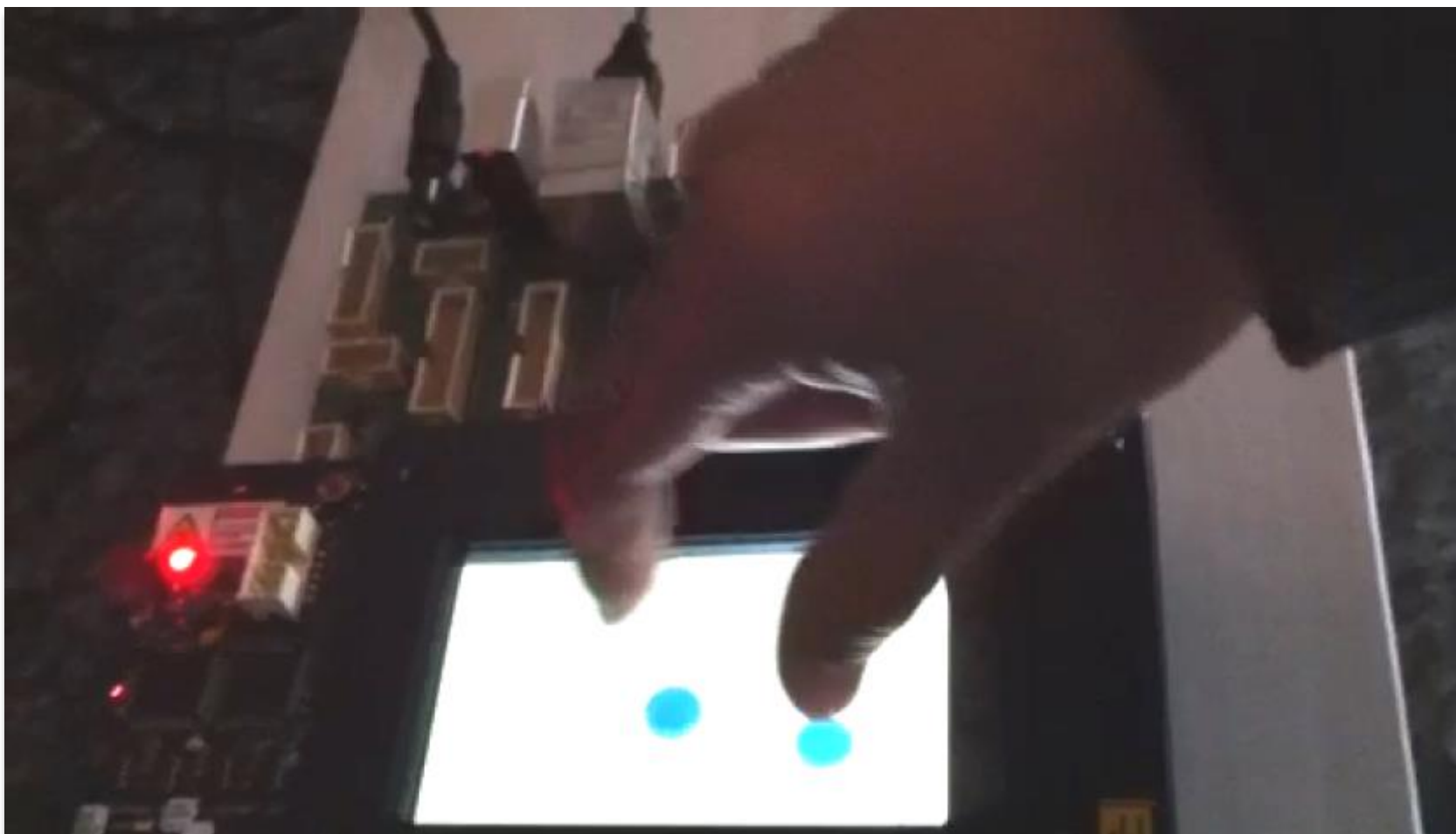


We can track multiple fingers above a smartphone display.

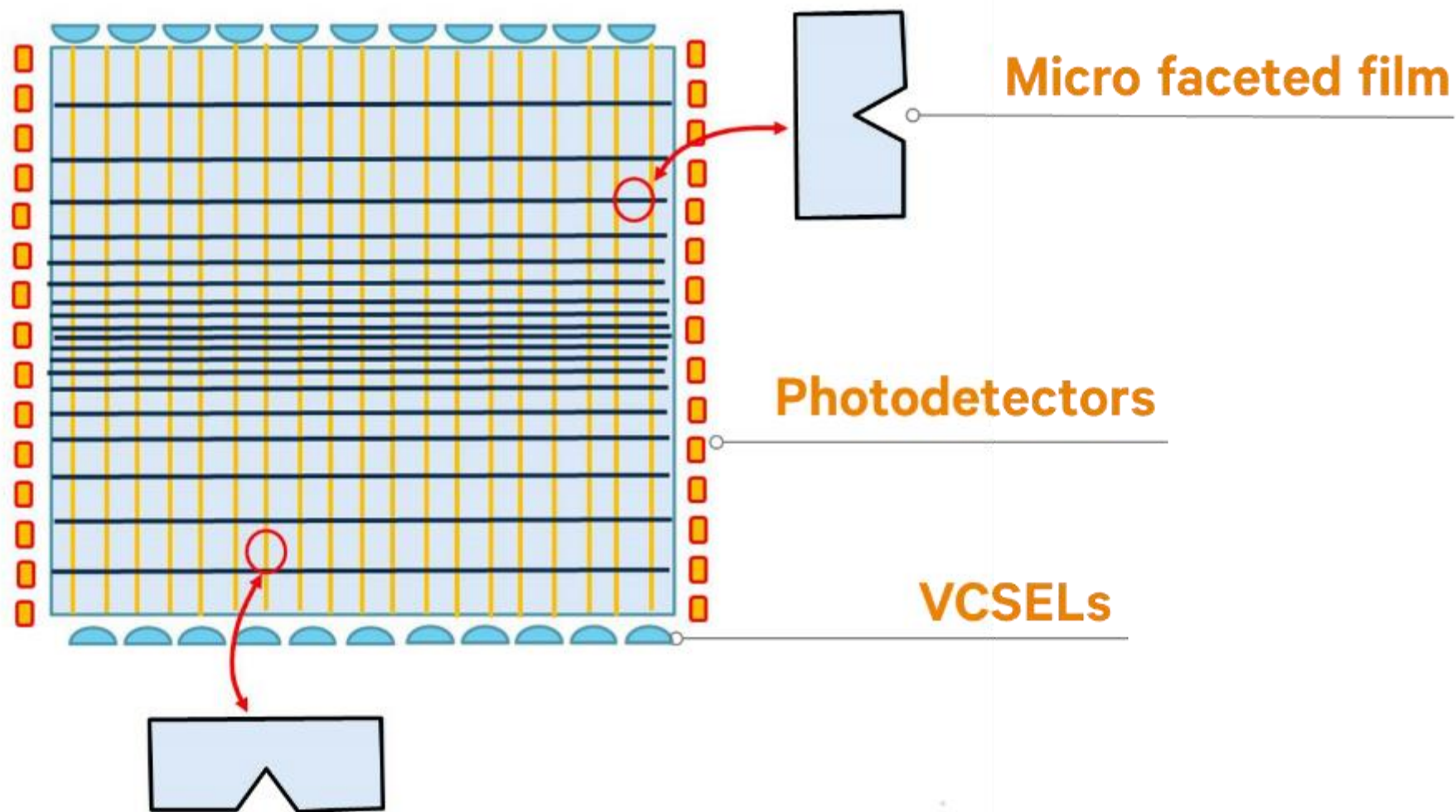


The tracking is fast.

Video of demo
running at 60 FPS

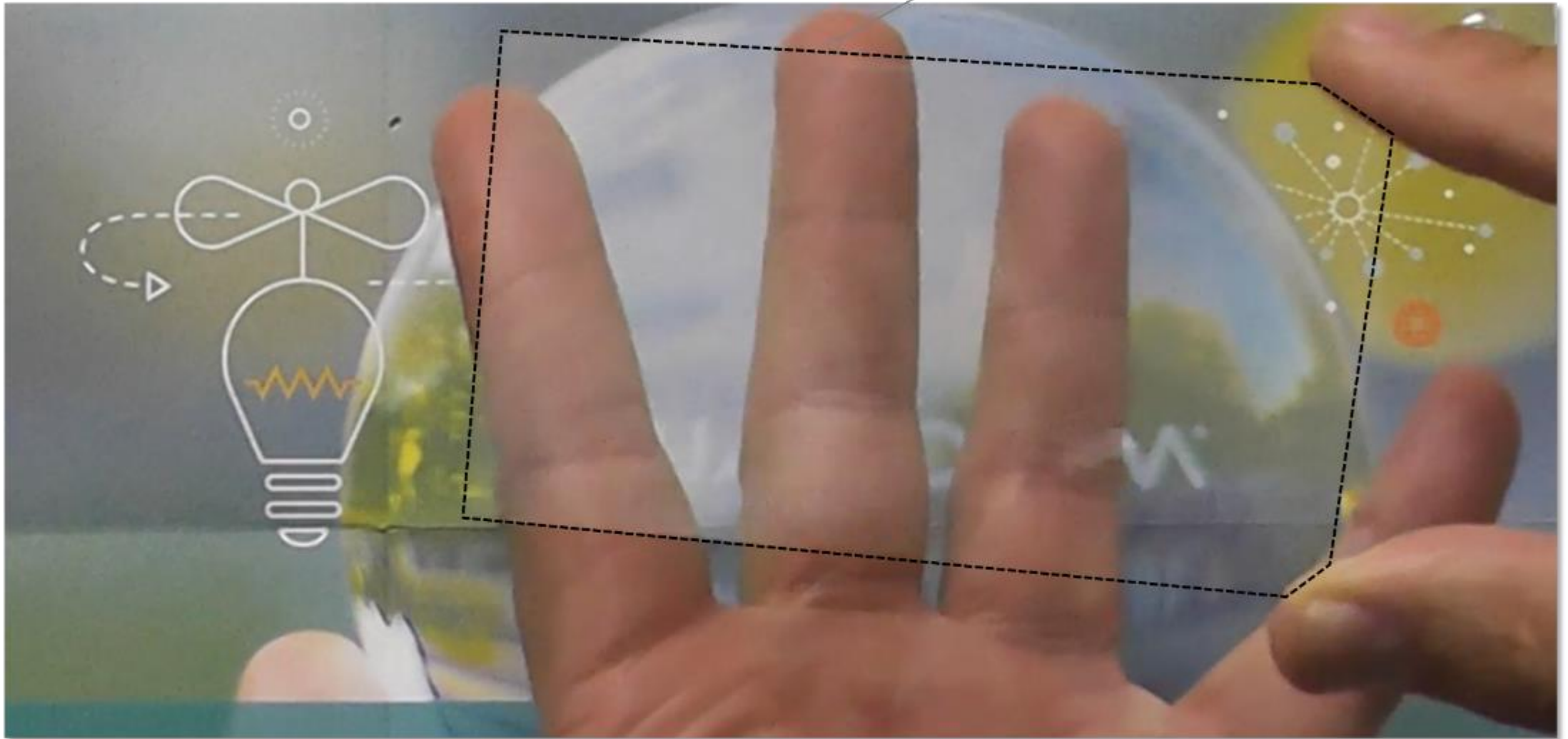


Here's how it works.

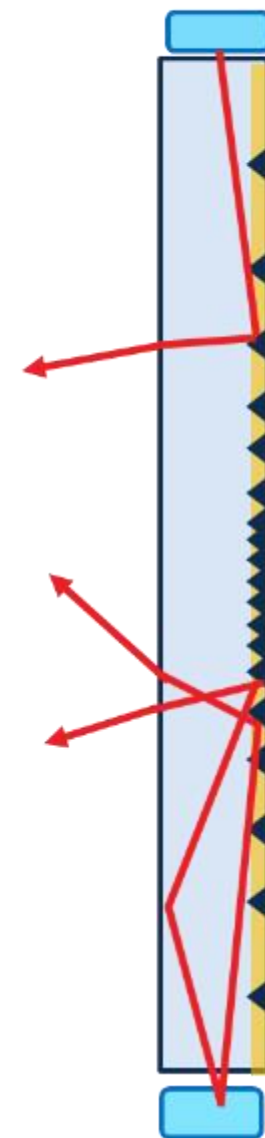
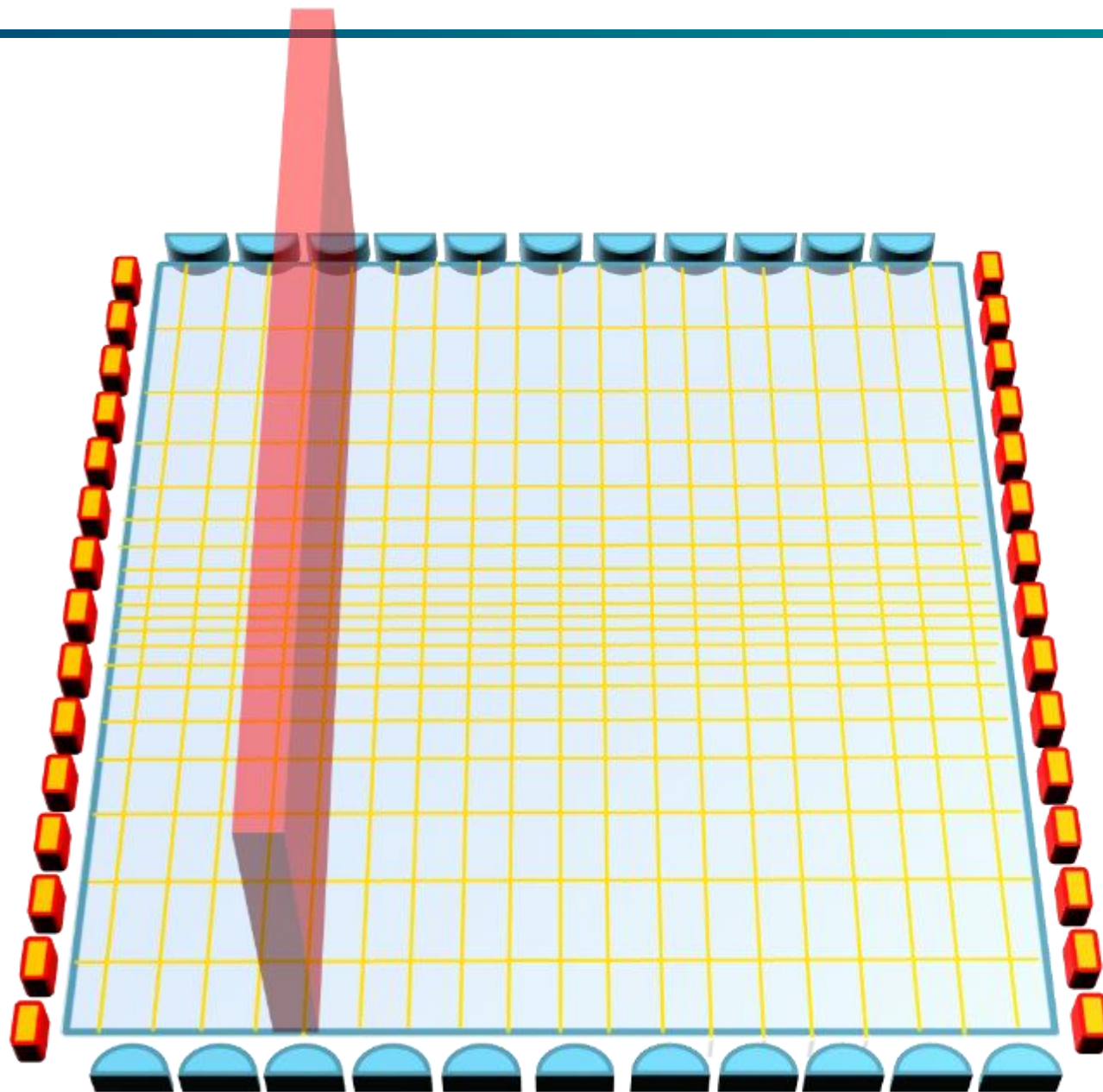


The film is transparent.

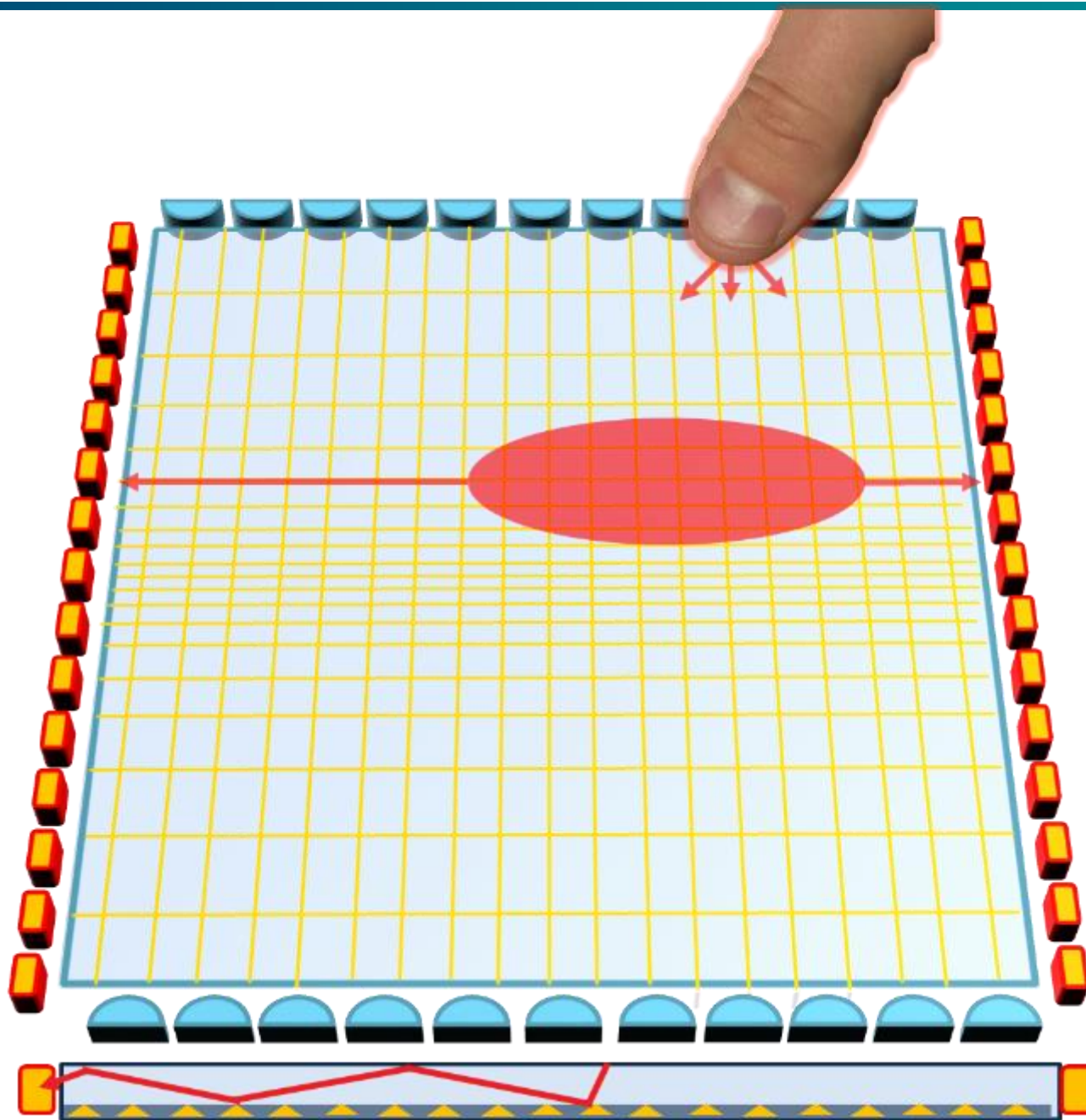
Outline of film



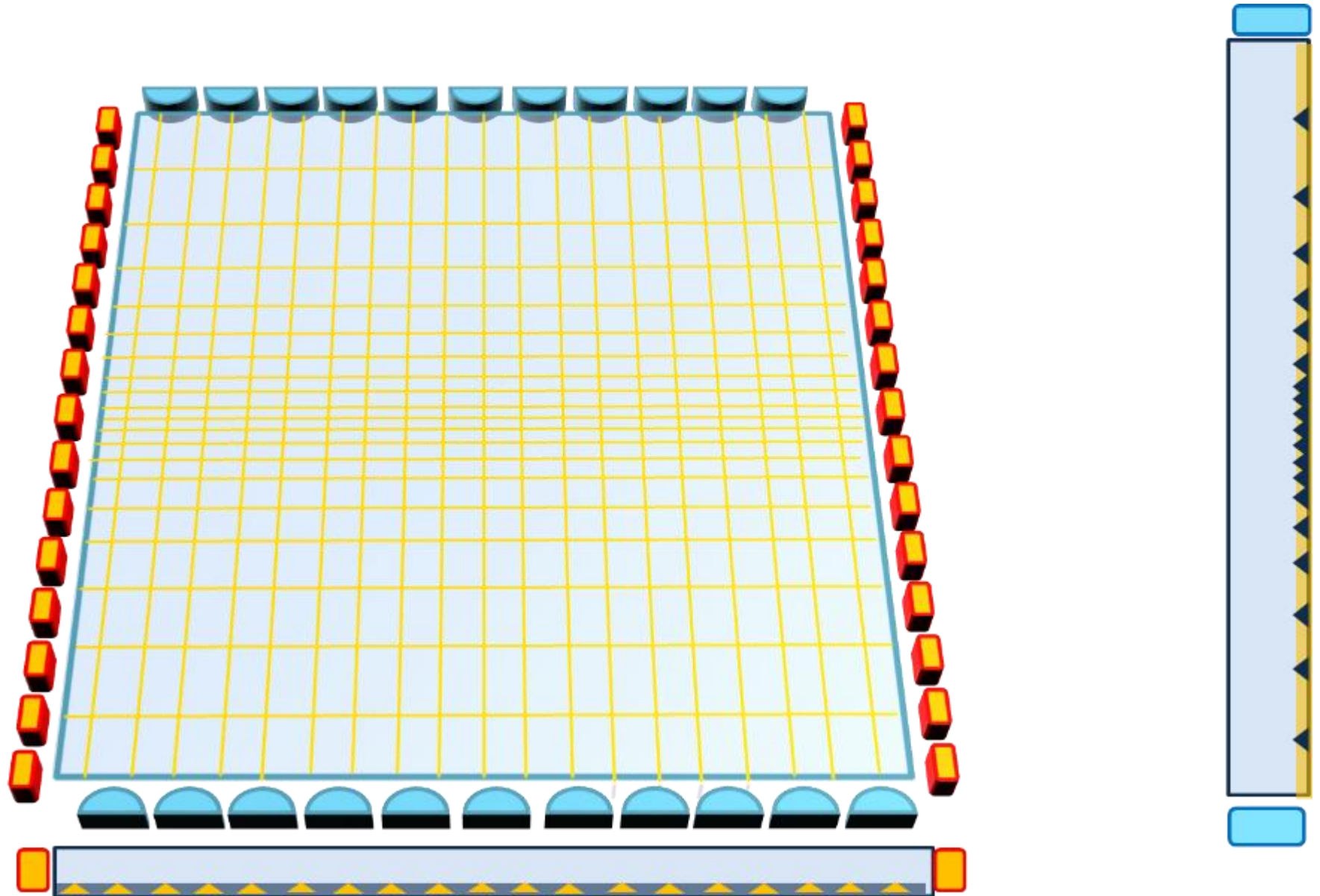
Illumination



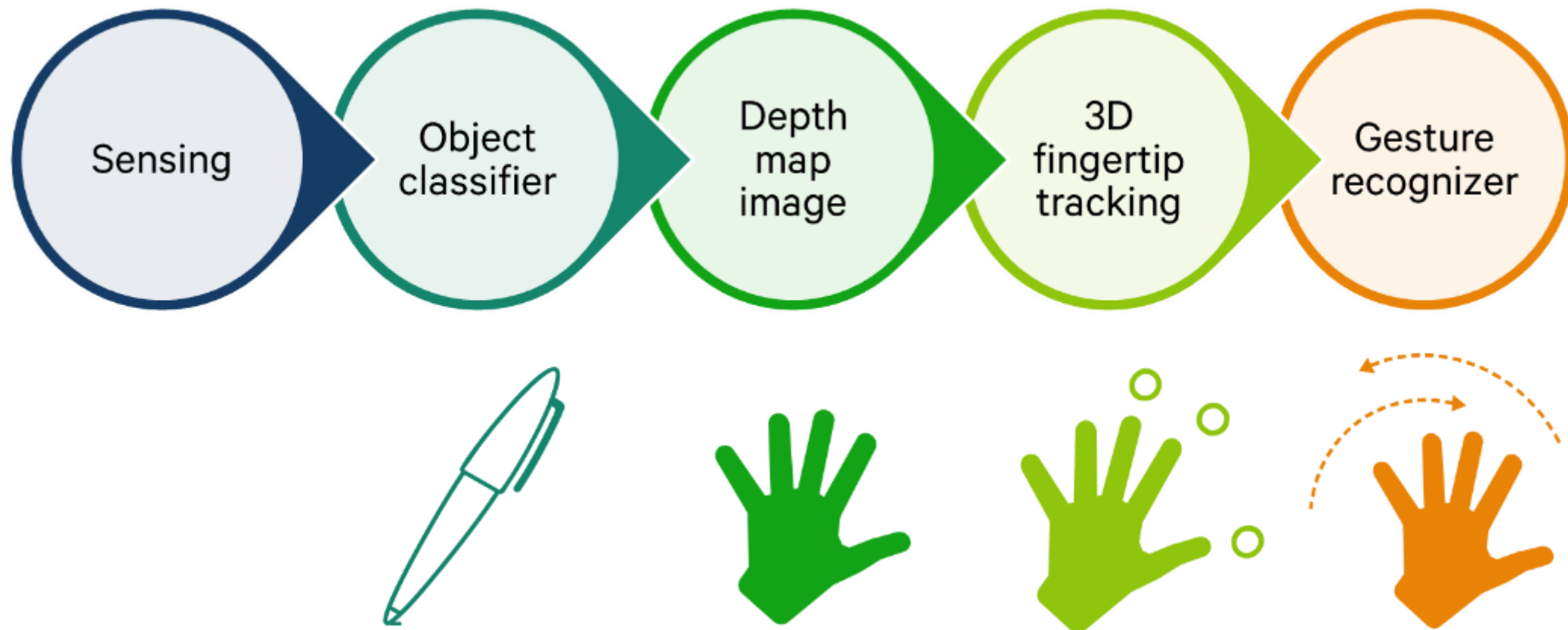
Light collection



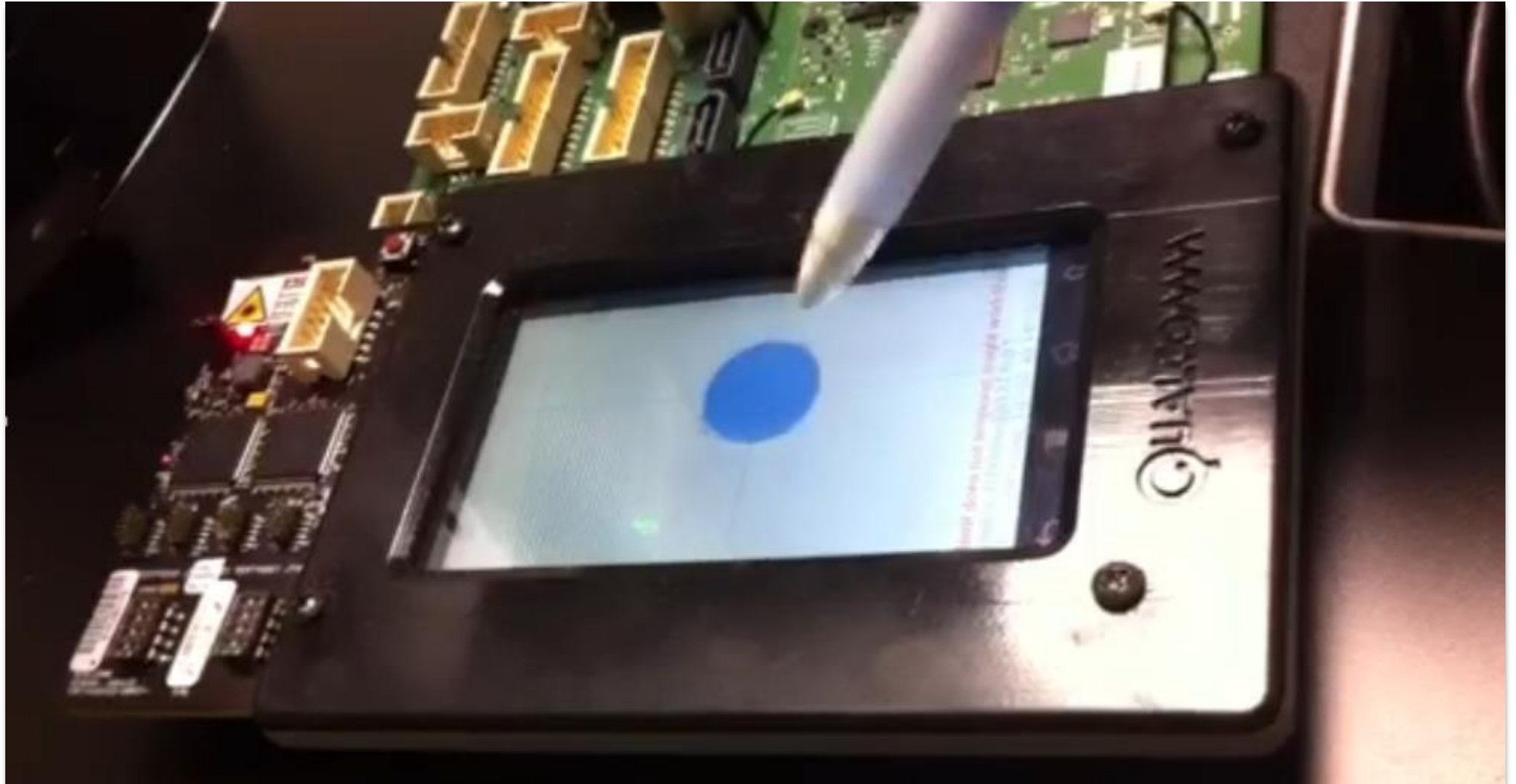
The film allows a flat bezel and works on curved displays.



This sensor enables multiple levels of interaction.



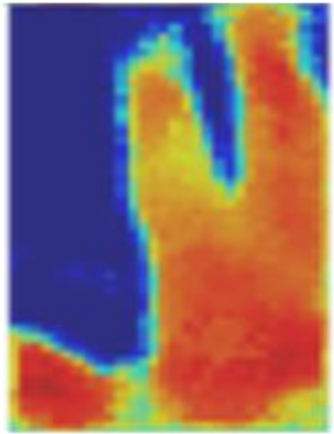
Passive and active styluses are detected.



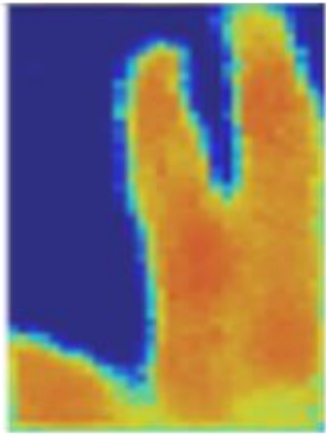
Video of
passive stylus

The sensor estimates a depth map of the user's hand.

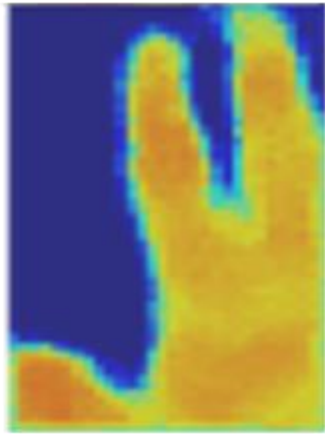
Depth maps



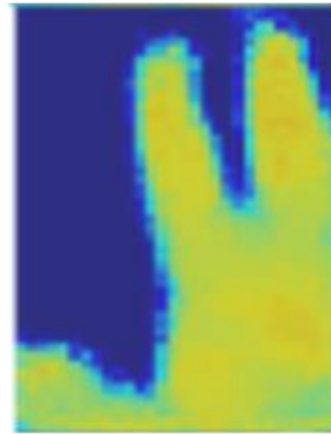
Surface



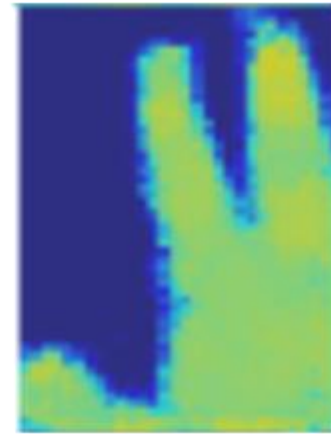
20 mm



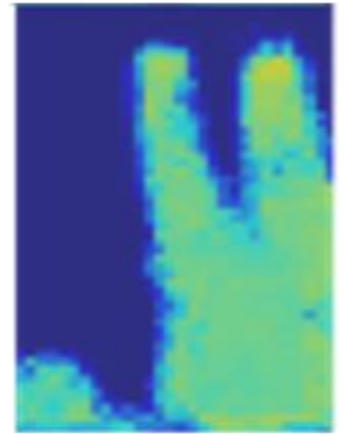
40 mm



60 mm

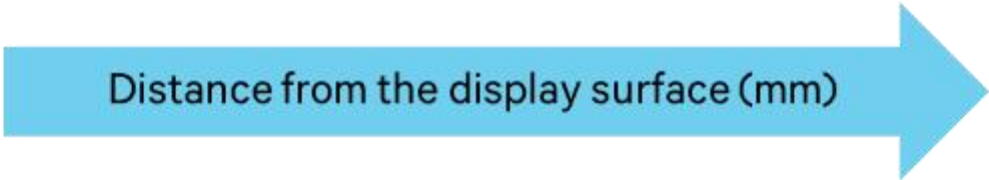


80 mm



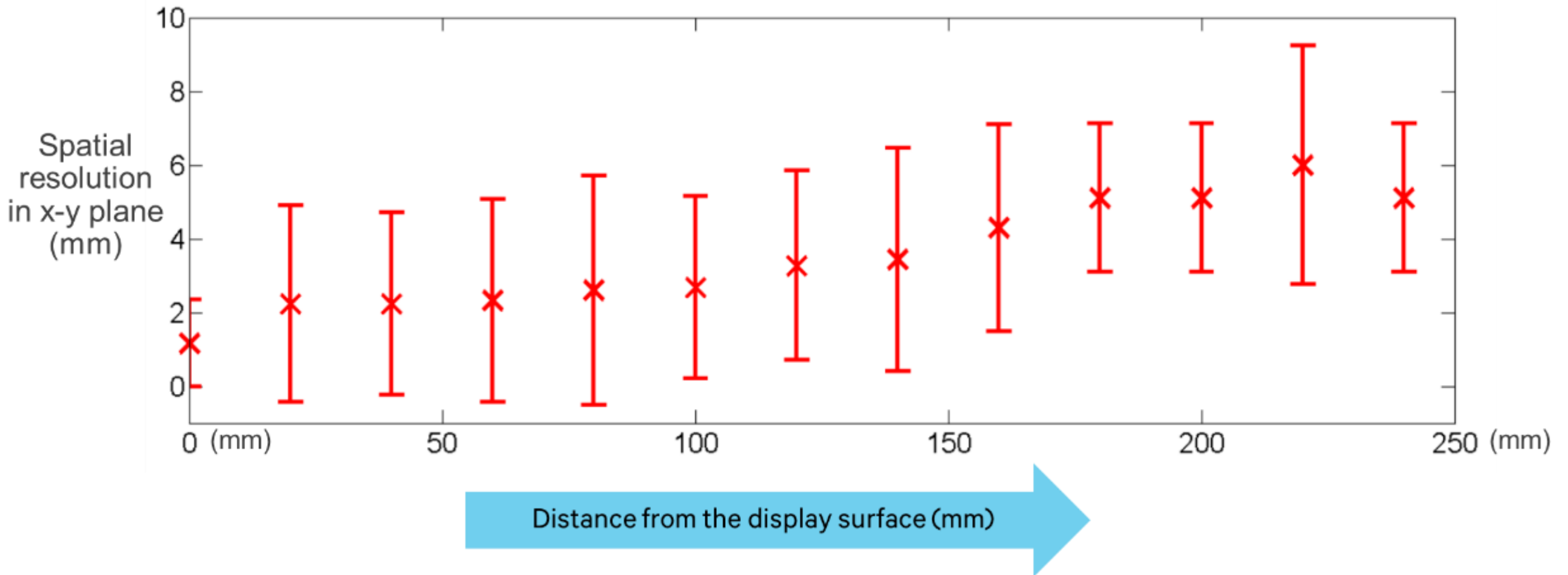
100 mm

Distance from the display surface (mm)



Finger-tips are accurately located and tracked.

On surface touch accuracy is similar to projected capacitance touch.



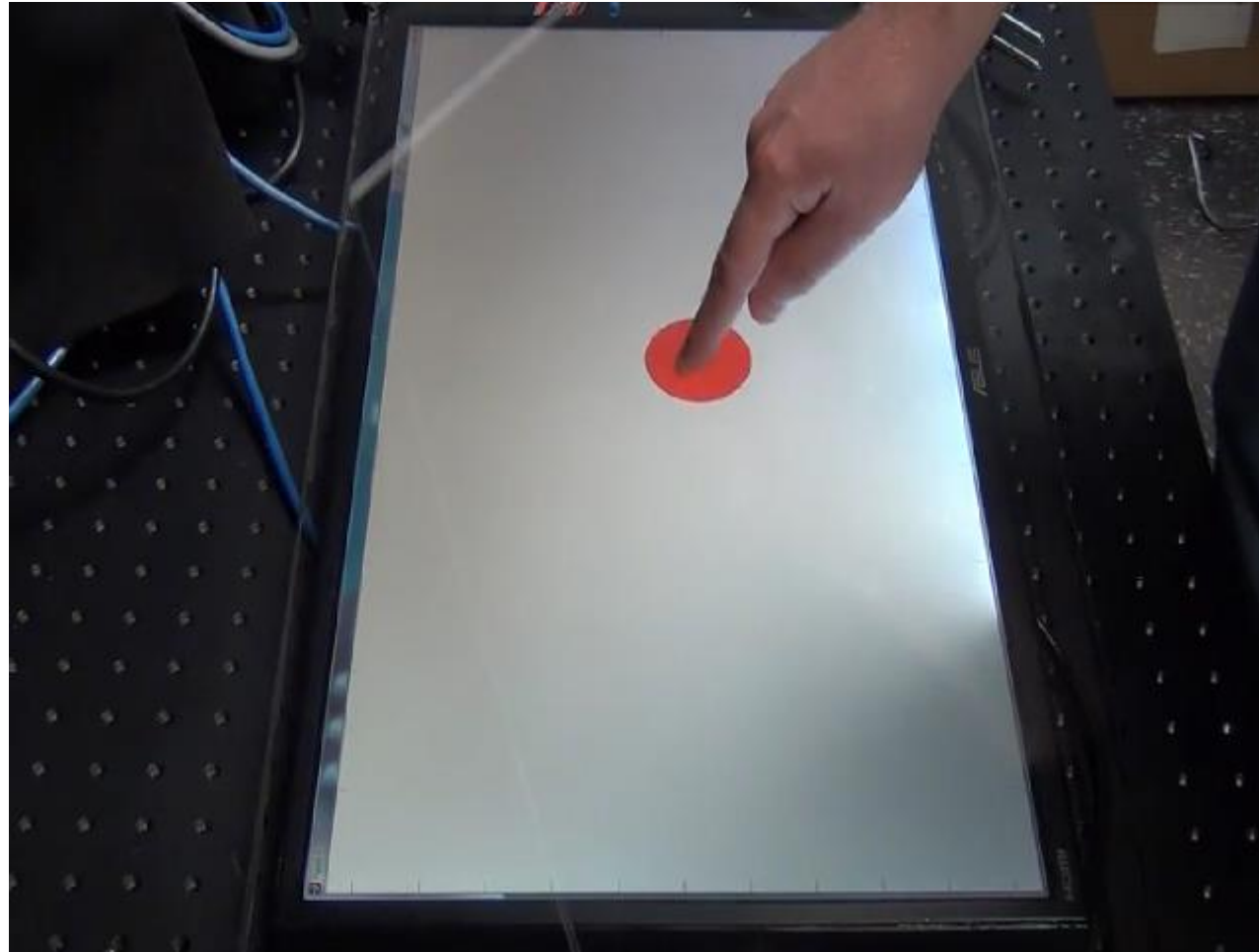
Complex gestures are recognized.

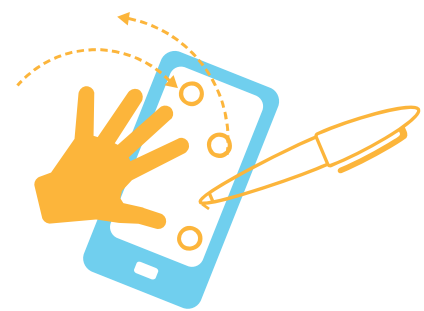
Video of air
pinches and
rotation gestures



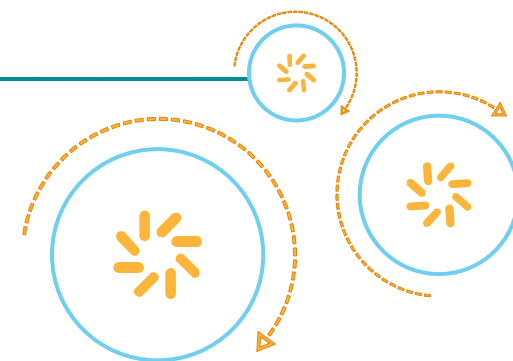
It is scalable to large areas.

Video of low
cost, large area
touch system





One technology enabling a seamless transition from touch, to complex 3D gestures, to stylus interaction



Thank you

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