Touch User Interfaces

CS4501/6501: Engineering Interactive Technologies

Seongkook Heo

Spring 2020, Department of Computer Science

Based on
Multi-Touch Systems that I Have Known and Loved by Bill Buxton and course materials by Geehyuk Lee

UNIVERSITY of VIRGINIA | SCHOOL of ENGINEERING & APPLIED SCIENCE

Assignment #1: Good UI, Bad UI (1/24)

- Find two **Good Computer User Interfaces**
- Find two **Bad Computer User Interfaces**
- Explain **why you think they're good or bad**
- Find **those that aren't traditional ones** (non keyboard/mouse)
- Best ones will be introduced in the class
- 5 / 20 points

Seongkook Heo,
CS6501– Engineering Interactive Technologies
HW 1
1/15/2019

Good UI #1: XXX

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Good UI #2: XXX

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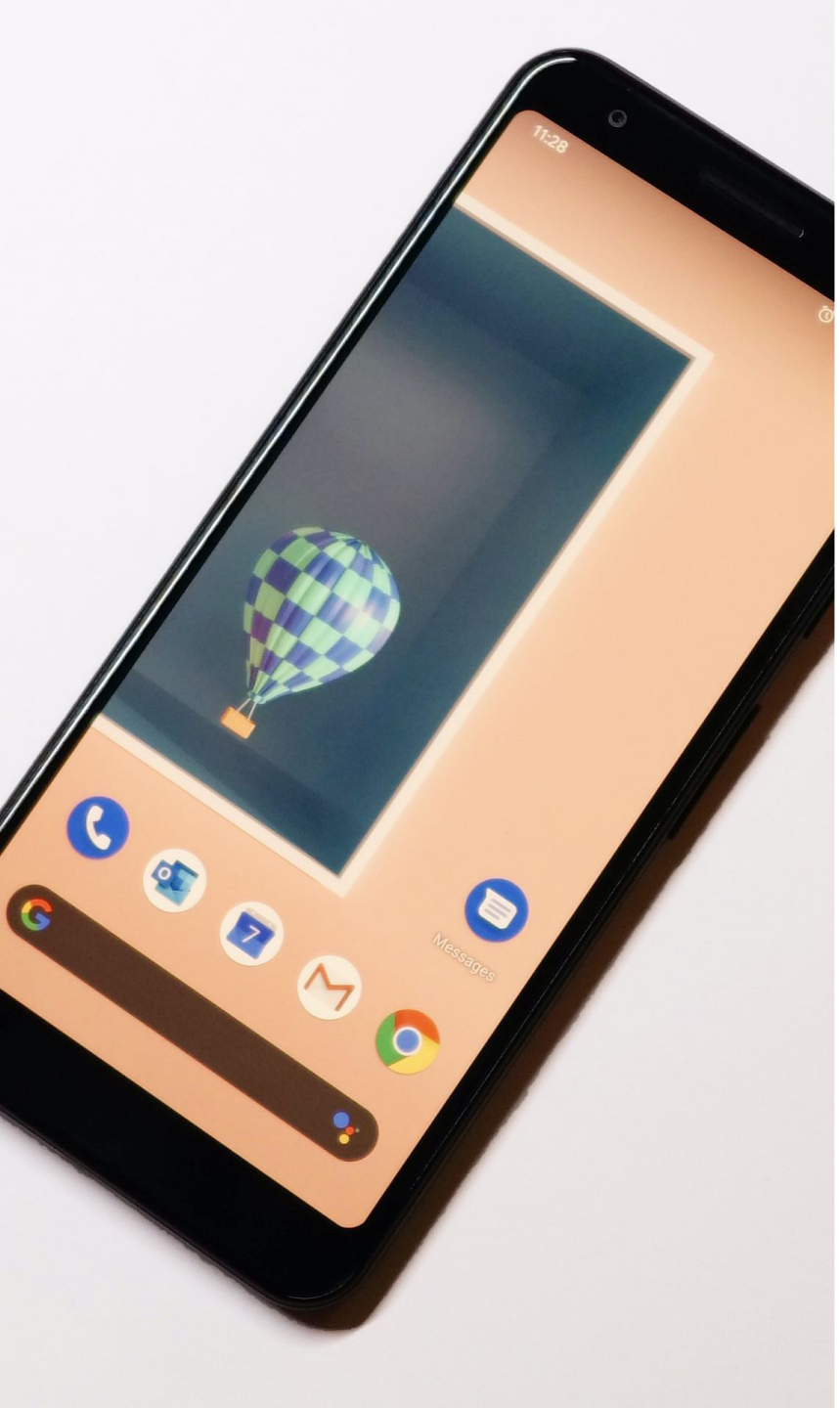
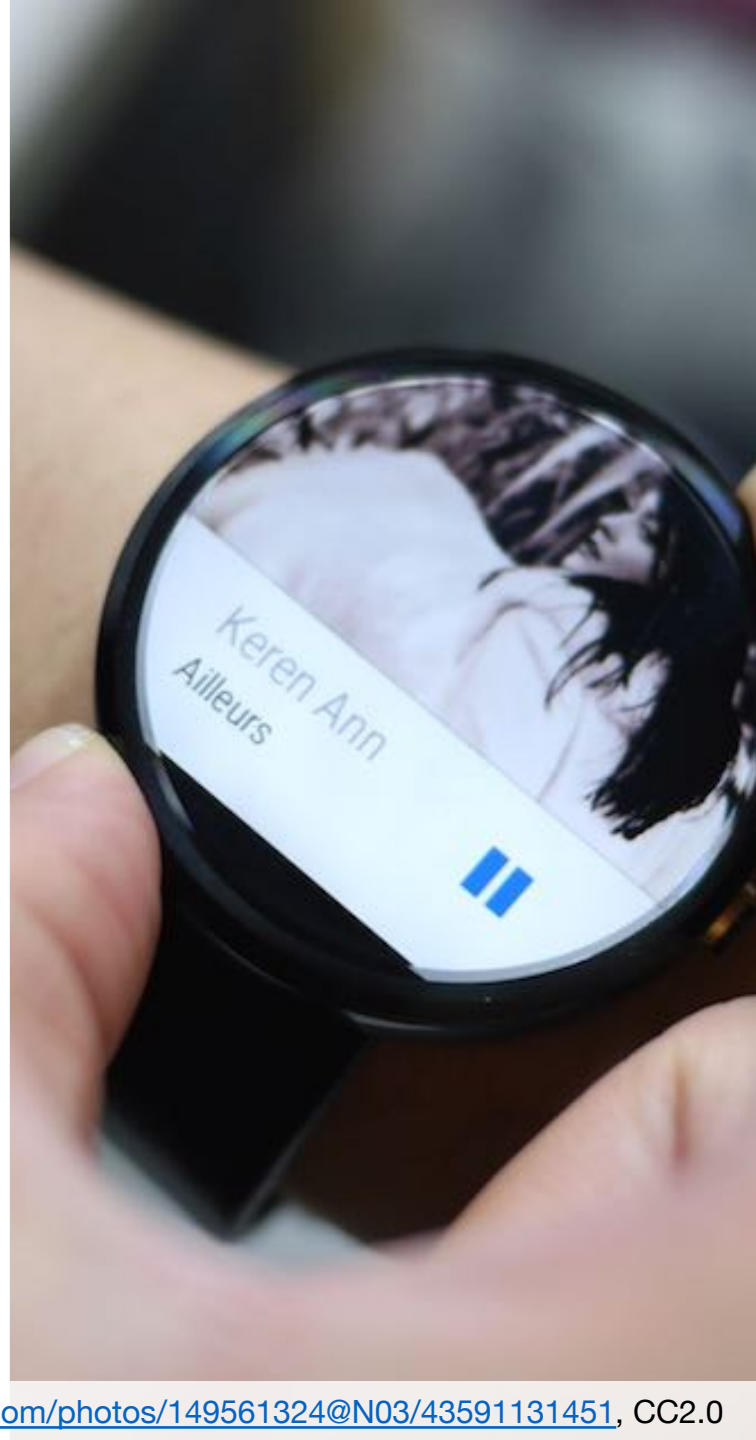
Top HCI Research Conferences

- **CHI (1982 -)**
  ACM Conference on Human Factors in Computing Systems
- **UIST (1988 -)**
  ACM Symposium on User Interface Software and Technology

- You can browse their proceedings on ACM Digital Library (https://dl.acm.org)
- CHI: https://dl.acm.org/doi/proceedings/10.1145/3290605
- UIST: https://dl.acm.org/conference/uist/proceedings

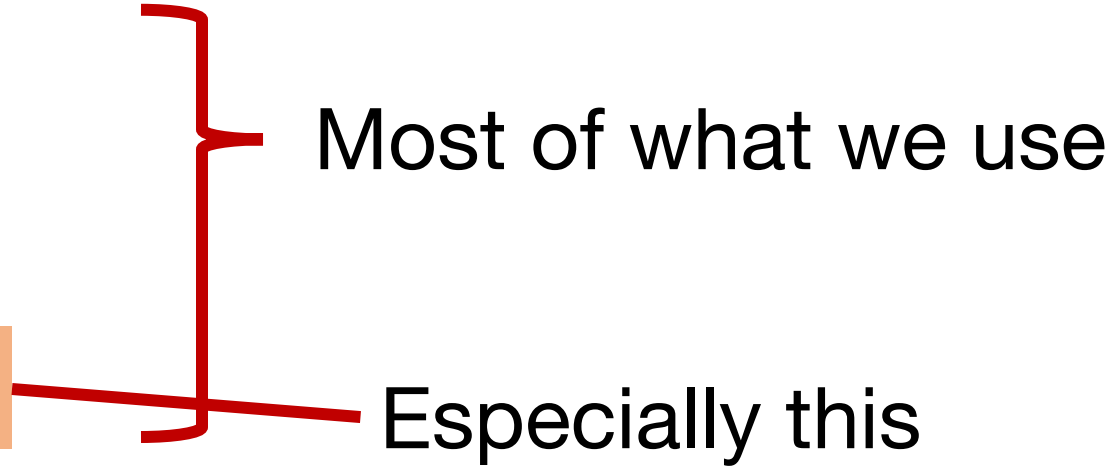




How do they know your touch?

Touch Sensing Methods

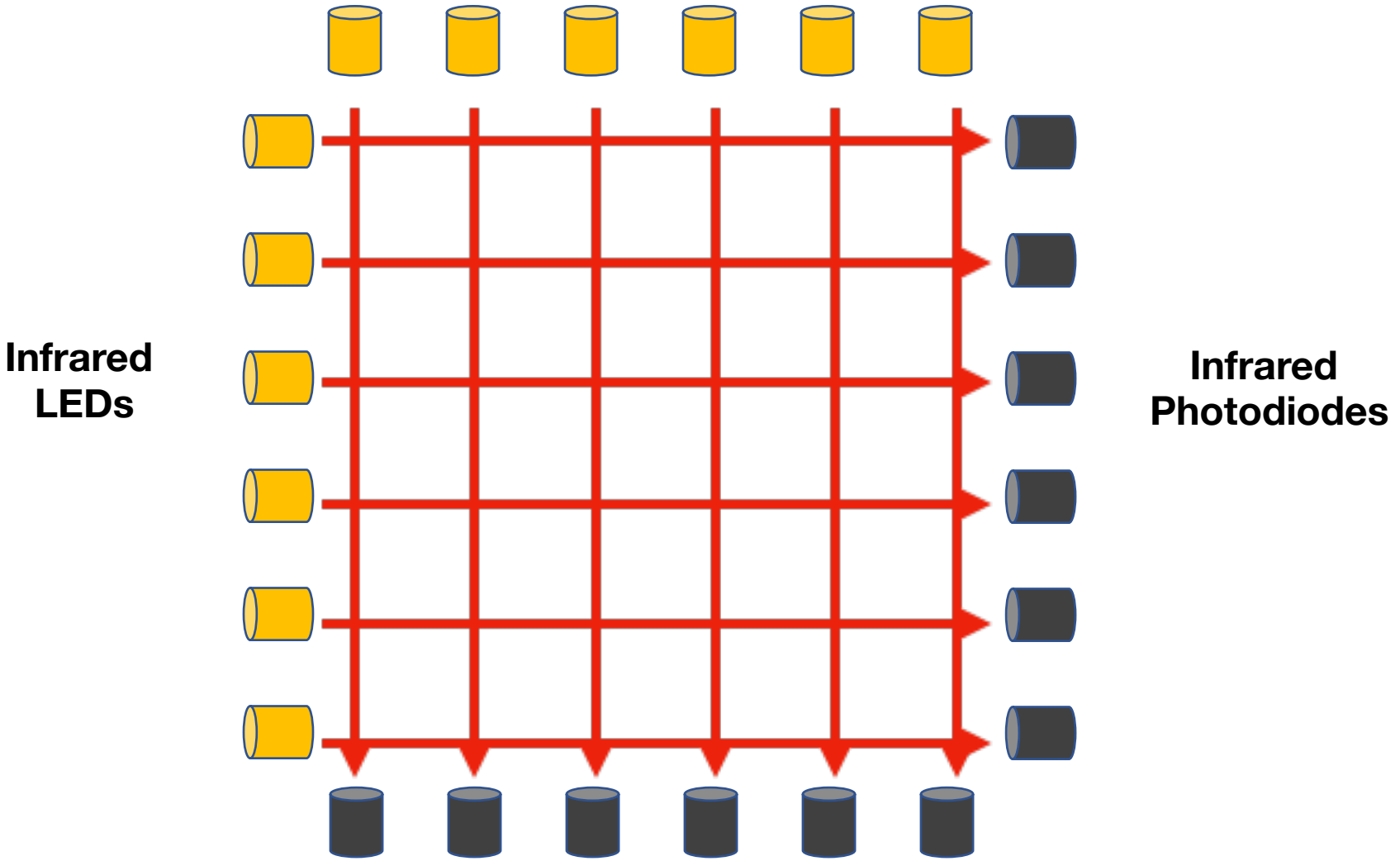
- Infrared Touch Panels
- Resistive Touch Panels
- Capacitive Touch Panels
- Camera-based Touch Panels



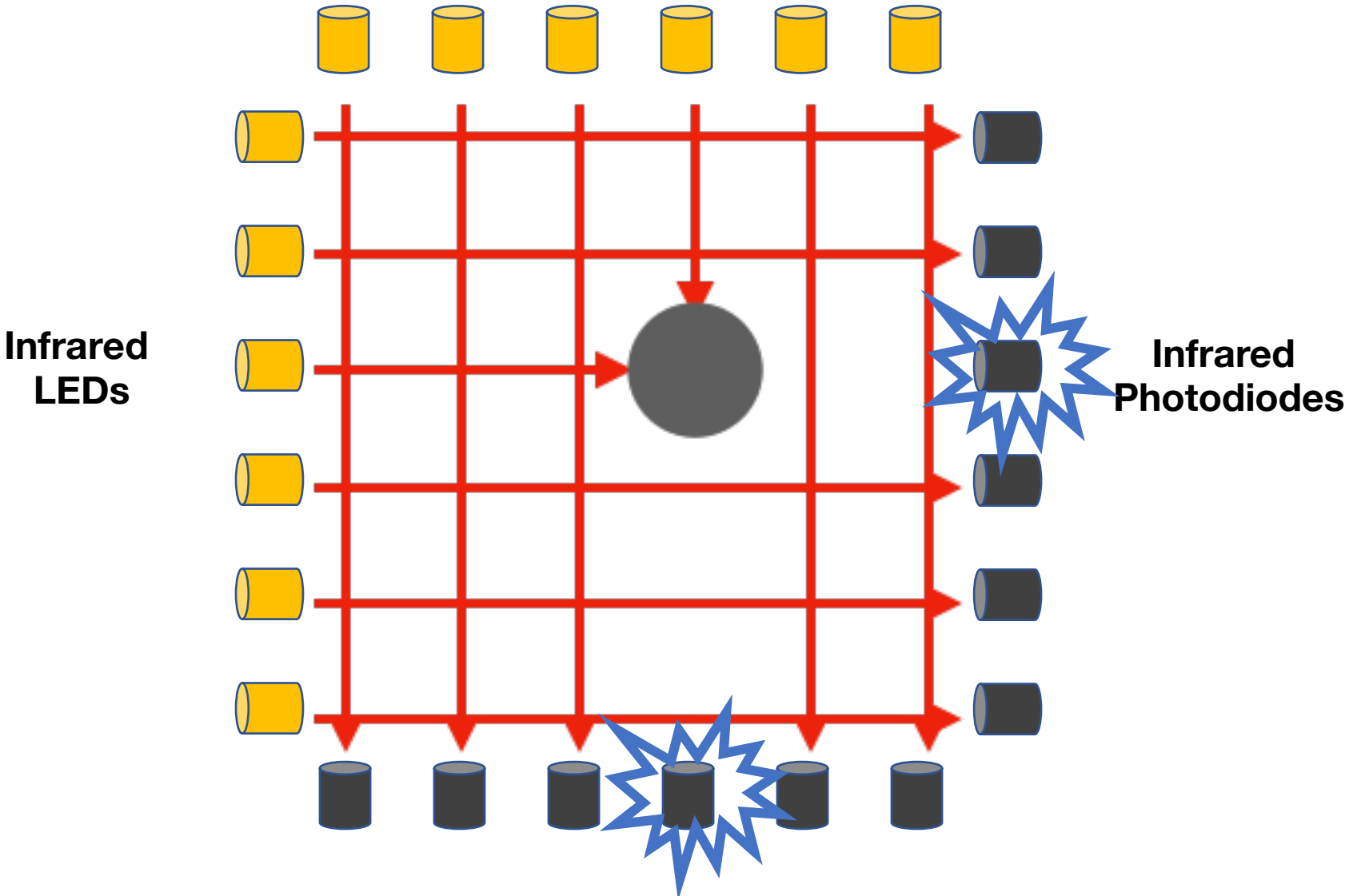
Infrared Touch Panels

Infrared Touch Panels

Infrared Touch Panels



Infrared Touch Panels

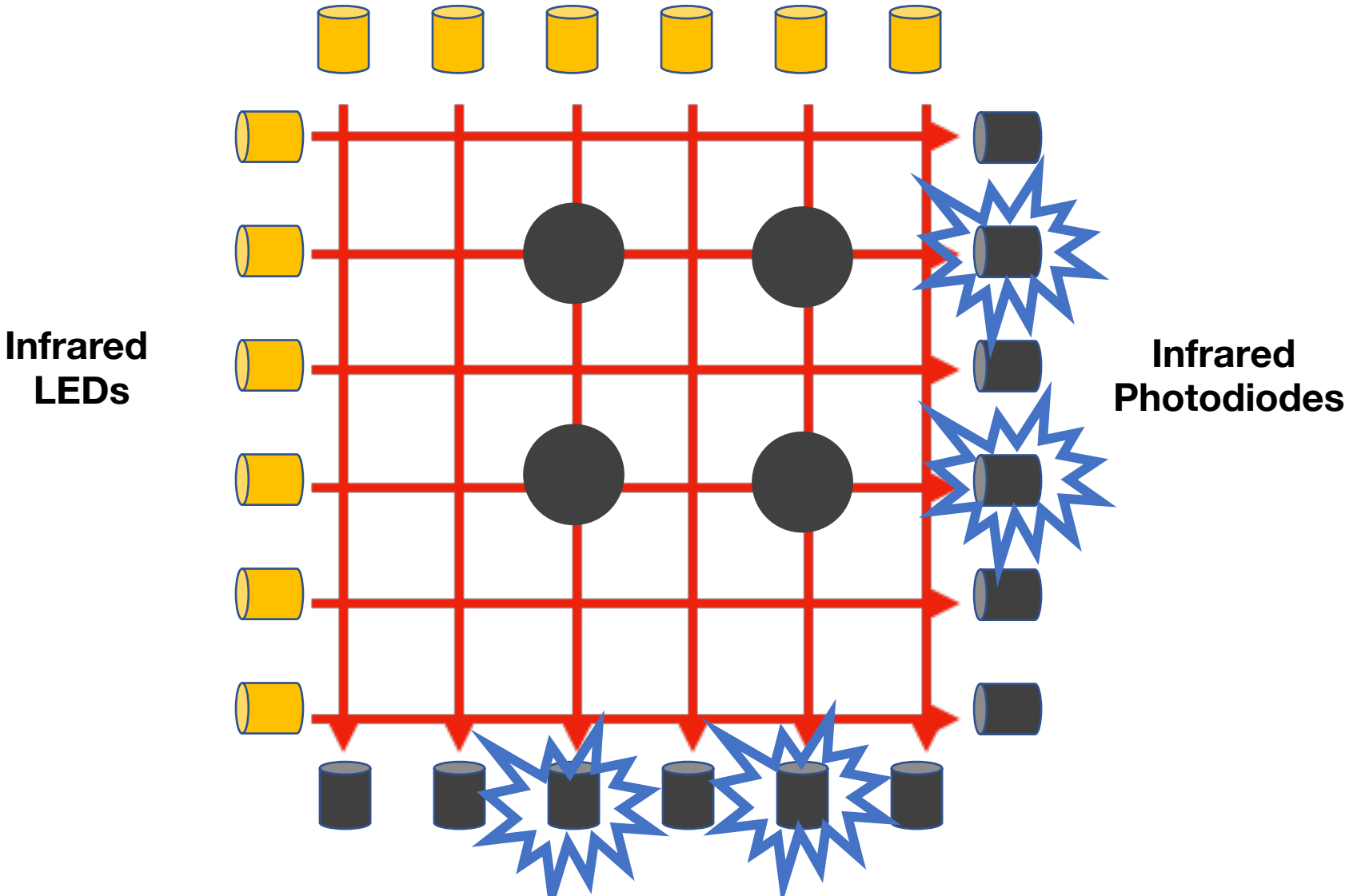


Infrared Touch Panels

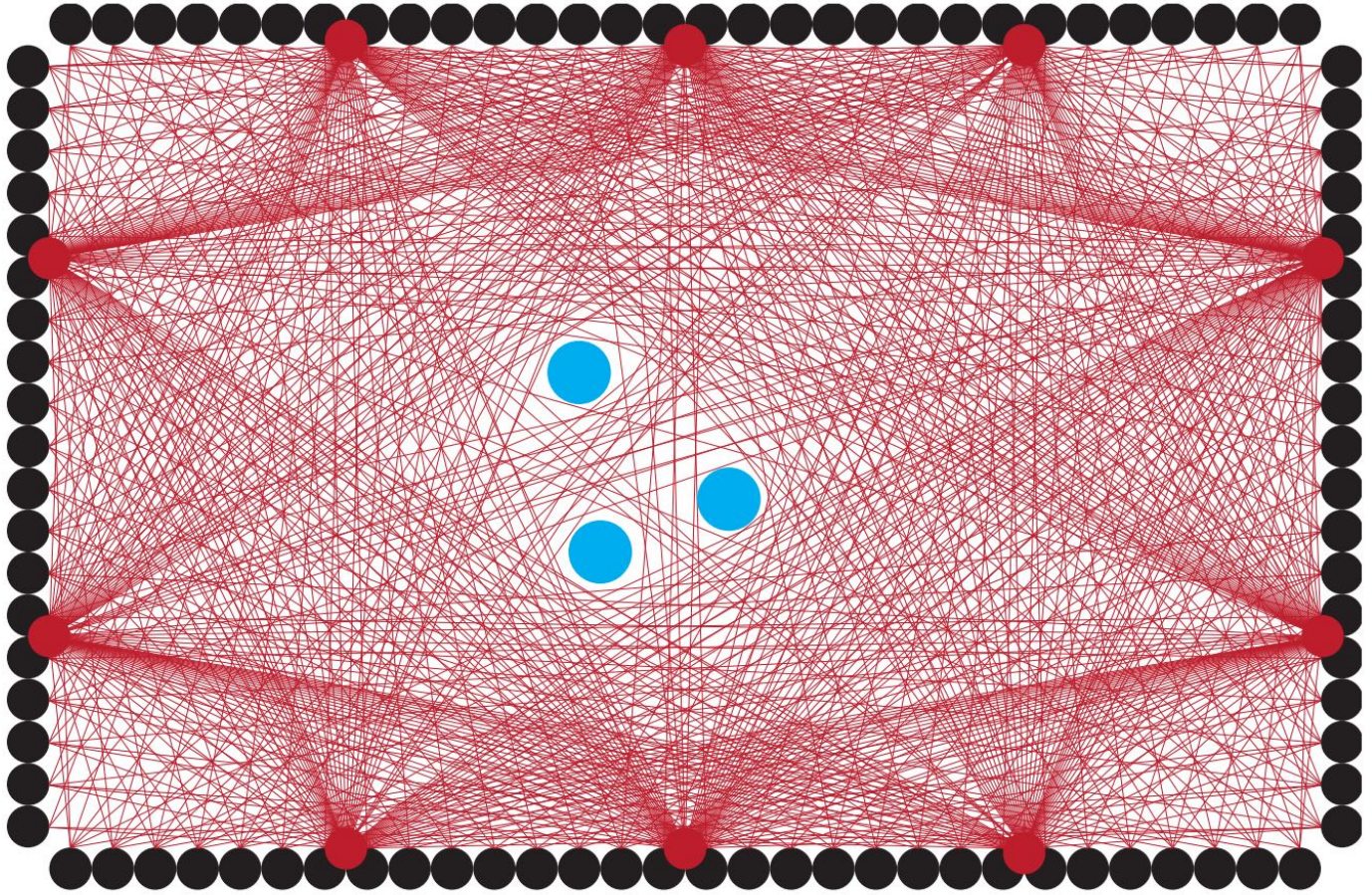
- PLATO IV Touch Screen Terminal (1972) used 16 x 16 infrared light beams.
- One of the first to be generally known

http://www.billbuxton.com/multitouchOverview.html

Infrared Touch Panels



ZeroTouch: Multi-touch Infrared Sensing



Moeller, J., & Kerne, A. ZeroTouch: an optical multi-touch and free-air interaction architecture. CHI 2012

Moeller, J., & Kerne, A. ZeroTouch: an optical multi-touch and free-air interaction architecture. CHI 2012

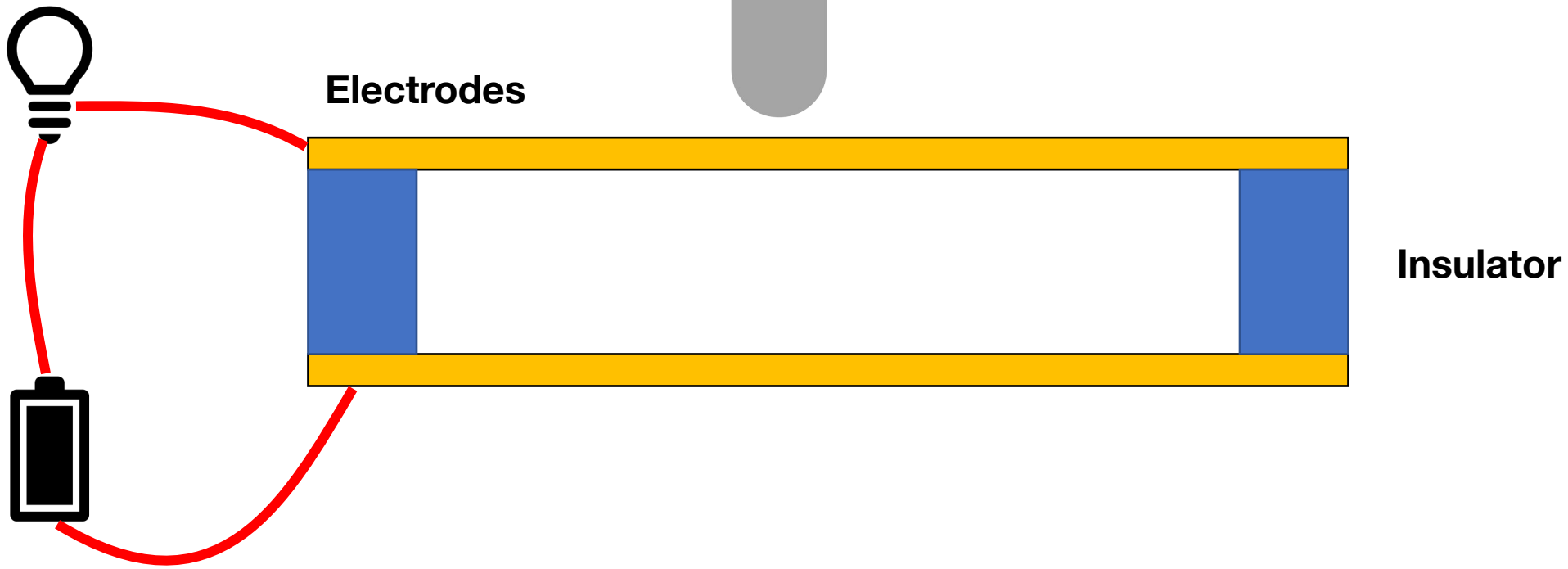
Infrared Touch Panels

- Pros
  - Durable
  - Can detect almost all kinds of objects (including gloves)
  - ➔ Used for ATMs and other machines that might be used with gloves
- Cons
  - Needs space above the surface
  - ~~Low resolution~~
  - ~~Detecting multi-touch is challenging~~
  - Not really a “touch”– your finger may not touch it but still trigger input

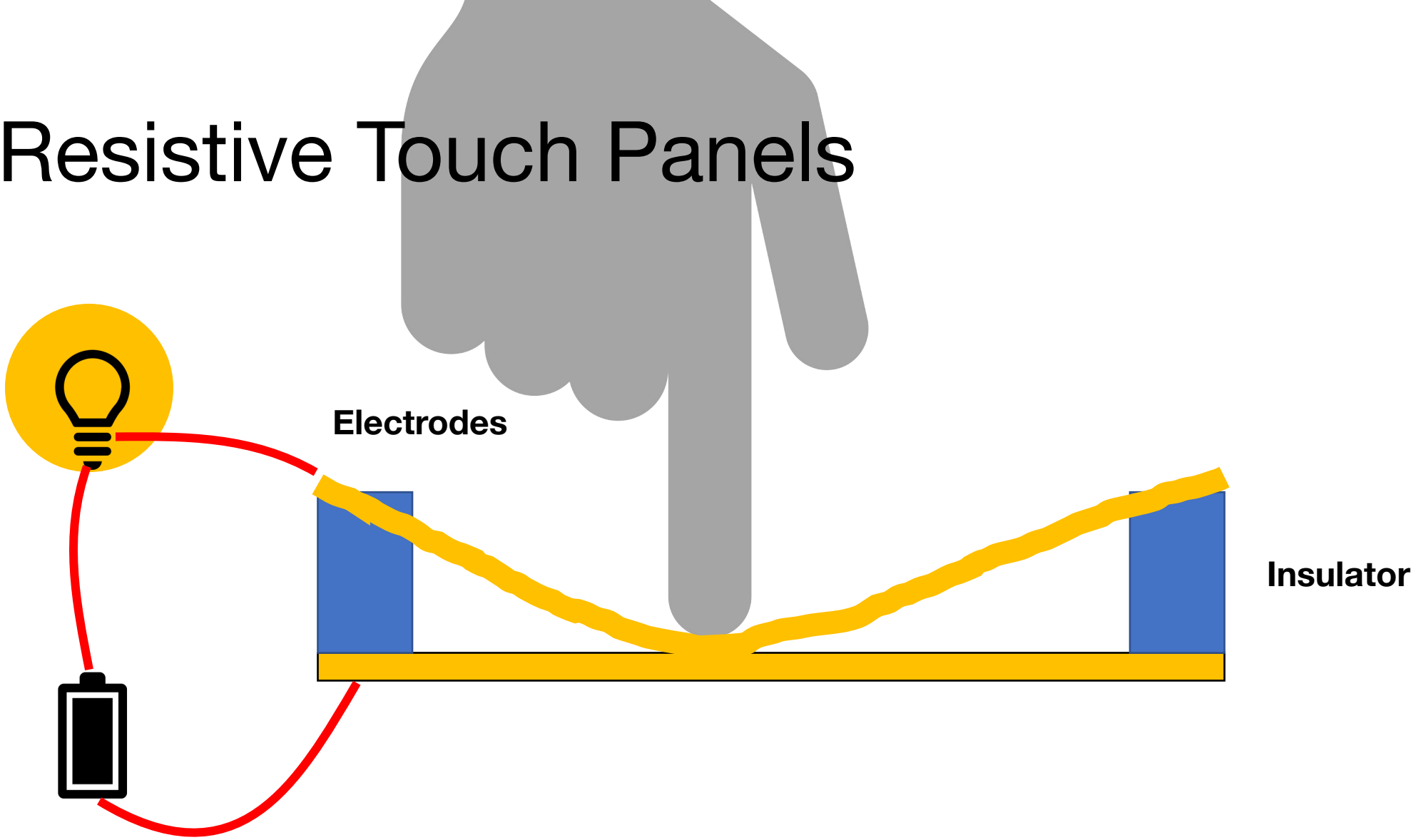
http://www.billbuxton.com/multitouchOverview.html

Resistive Touch Panels

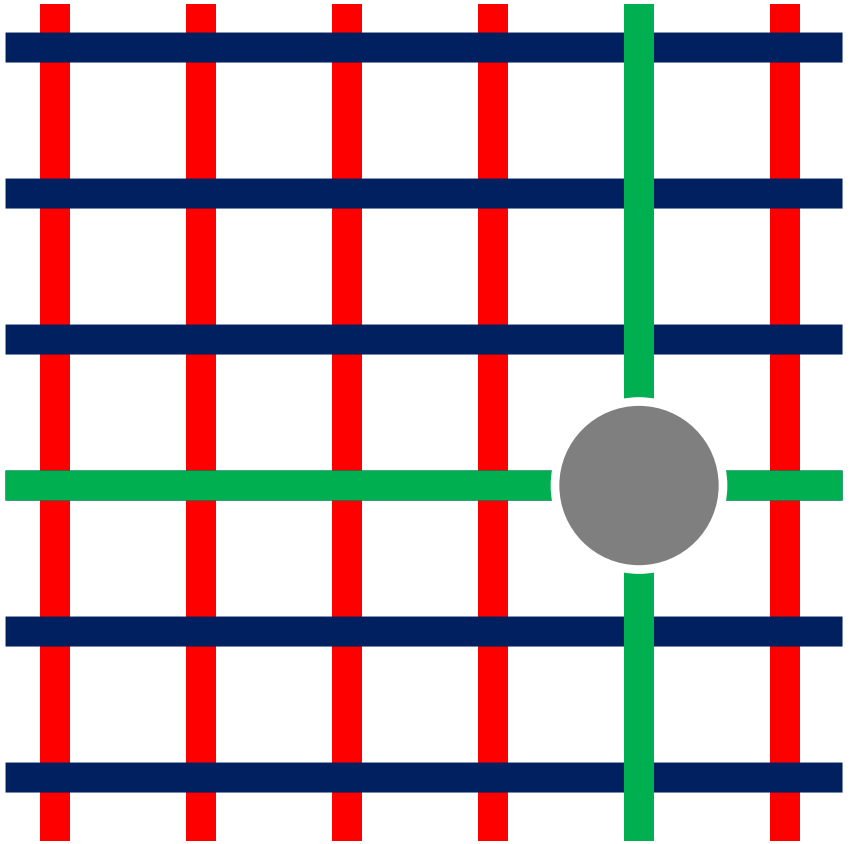
Resistive Touch Panels



Resistive Touch Panels



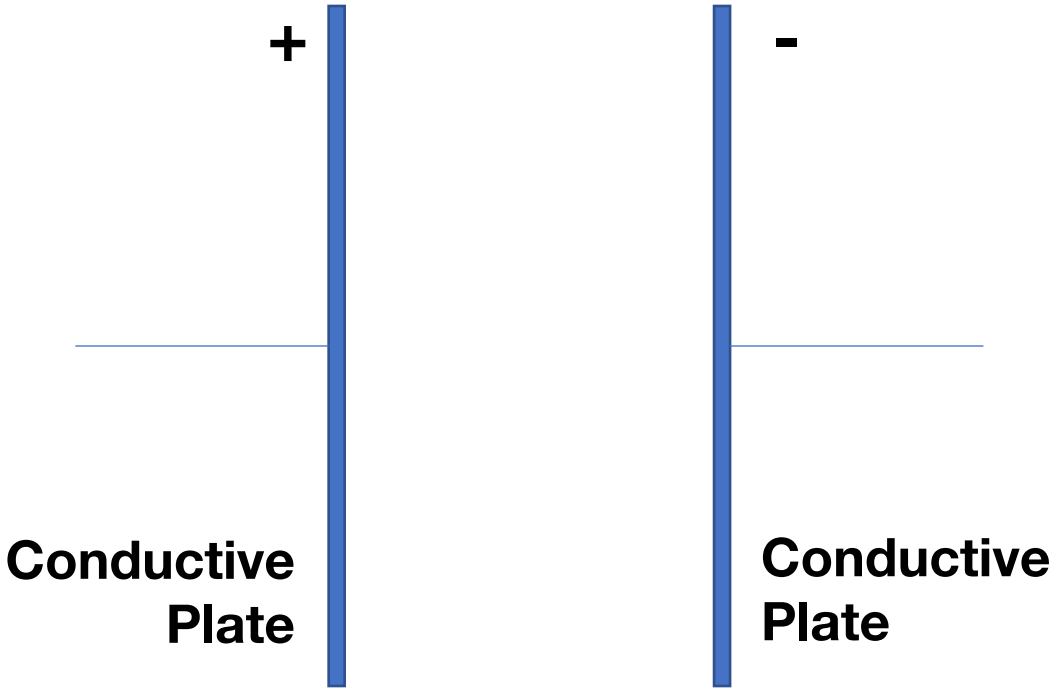
Resistive Touch Panels



Resistive Touch Panels

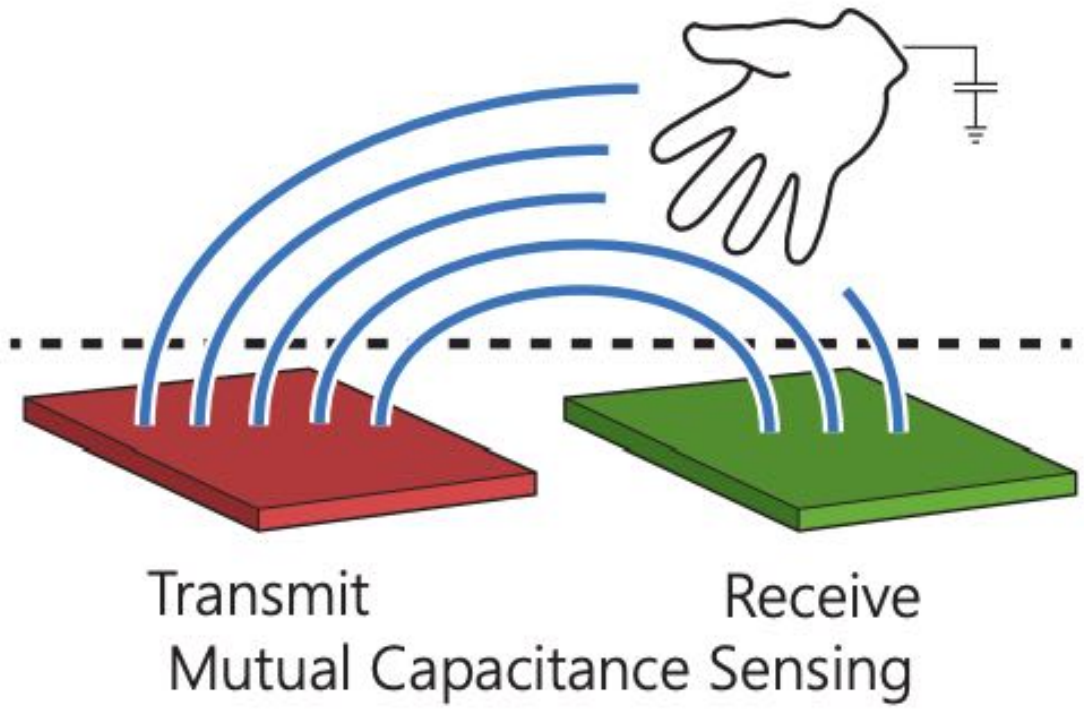
- Pros
  - Easy and cheap to manufacture – very widely used, especially for cheap appliances.
  - Can be used with objects and gloves
  - Robust to noise
- Cons
  - Not durable
  - Cannot detect light touch
  - Often require recalibration

Capacitive Touch Panels



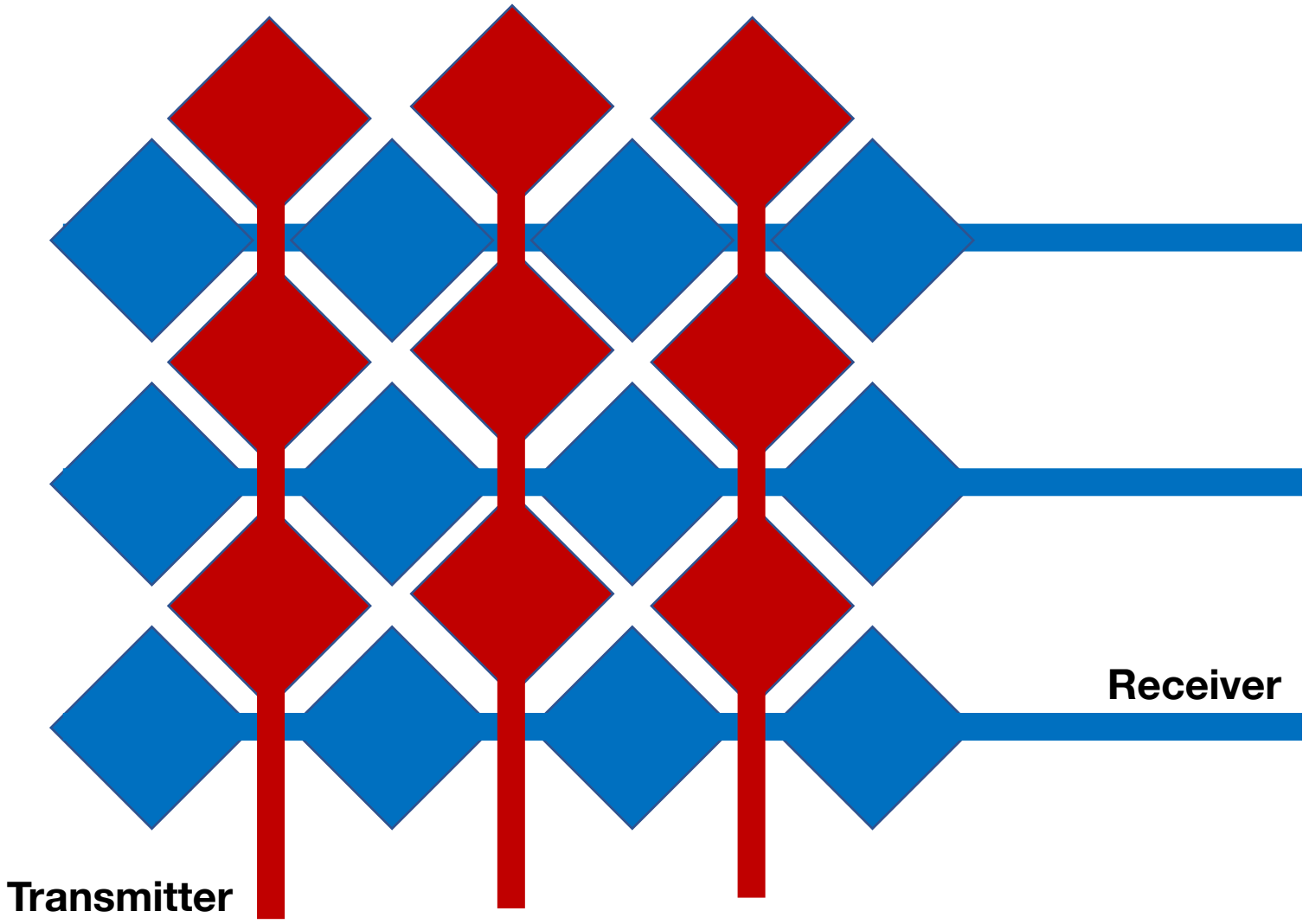
Capacitor

Capacitive Touch Panels

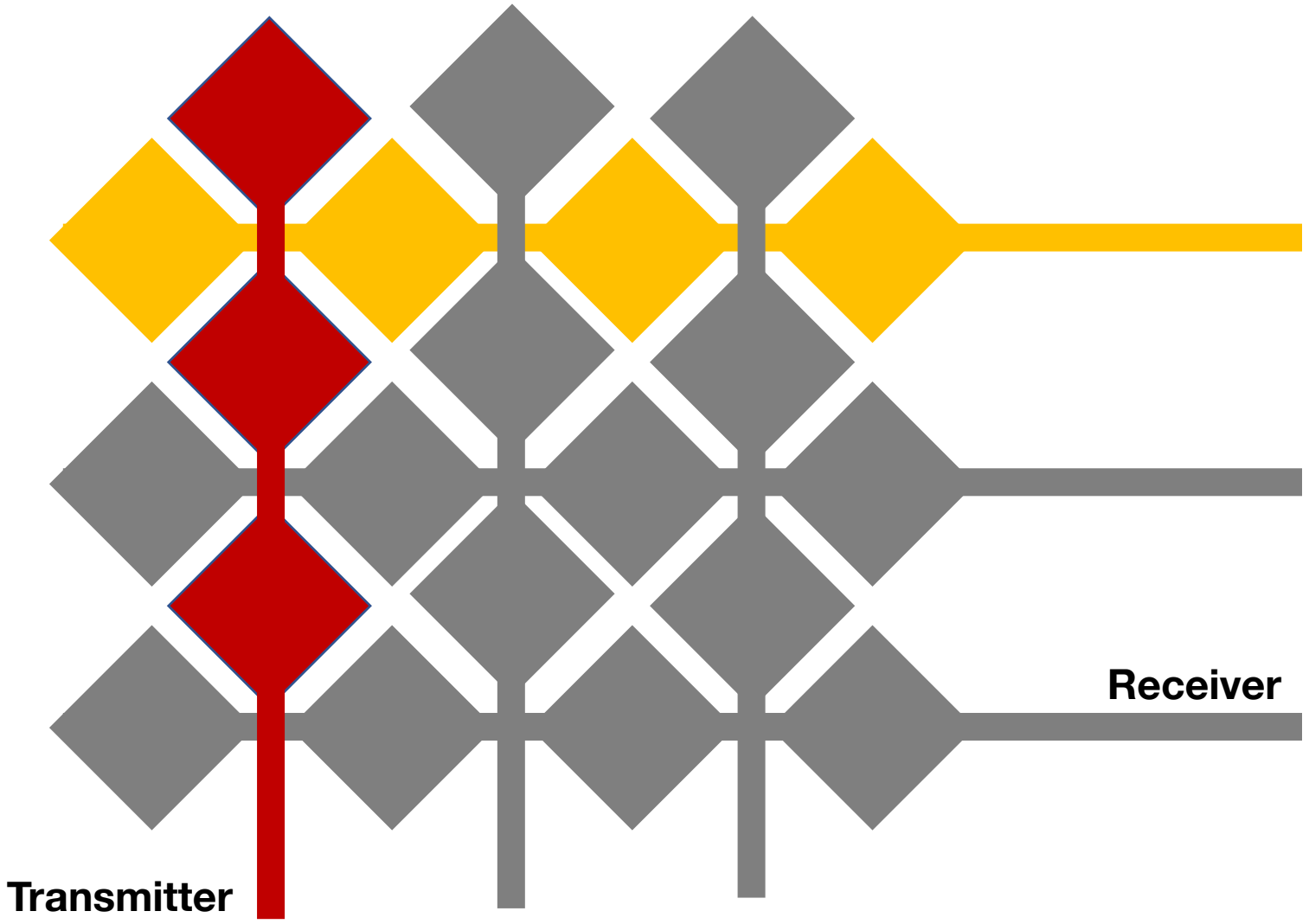


Grosse-Puppendahl et al.,
Finding common ground: A survey of capacitive sensing in human-computer interaction. CHI 17

Capacitive Touch Panels

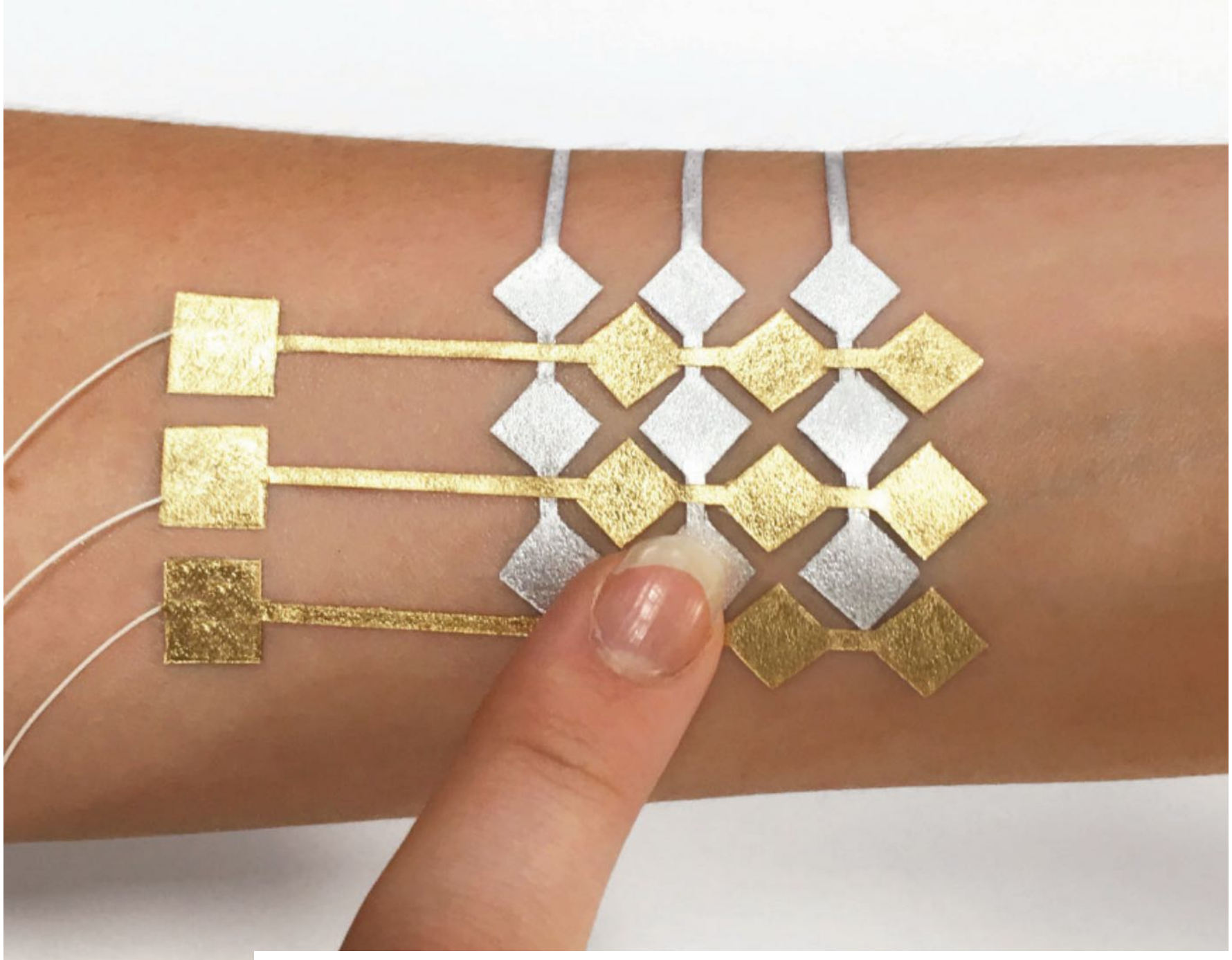


Capacitive Touch Panels



Capacitive Touch Panels

- Pros
  - High durability
  - Supports multiple touches
  - Adjustable sensitivity
  - Recognizes light touches
- Cons
  - More expensive than others due to the need for complicated controller
  - Only registers human body
  - Vulnerable to noise

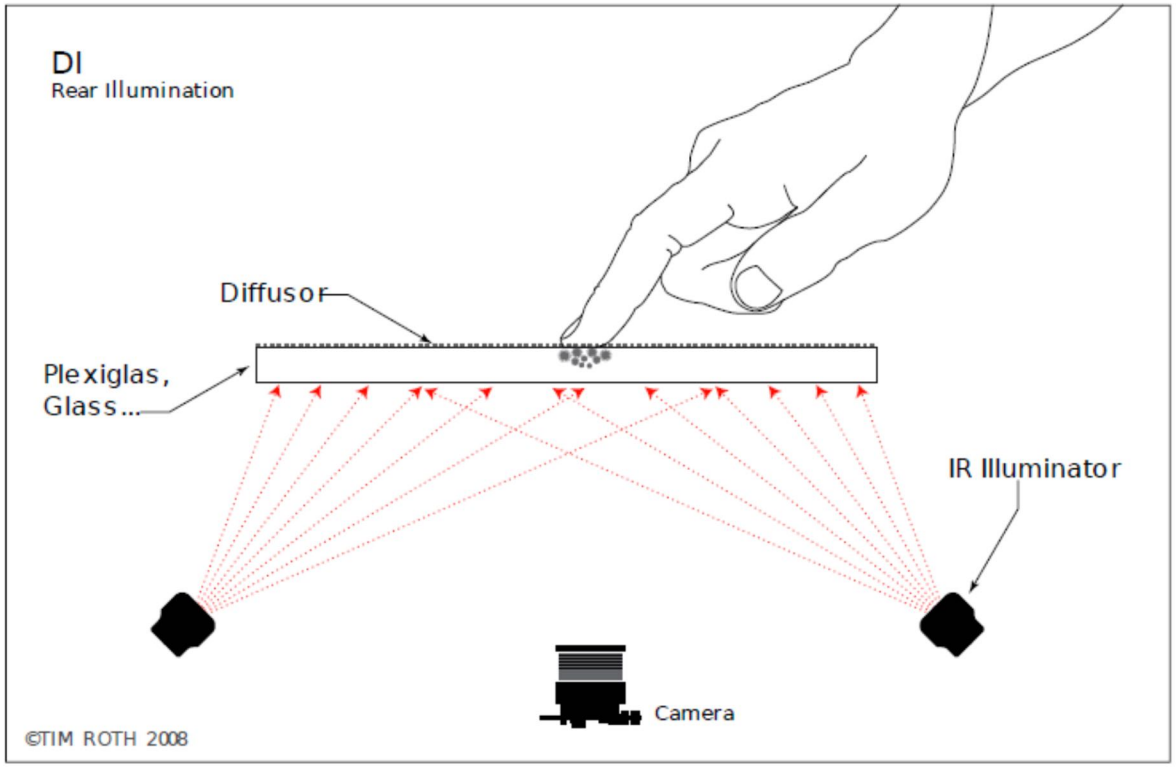


Kao et al., DuoSkin: Rapidly Prototyping On-Skin User Interfaces Using Skin-Friendly Materials, ISWC'16

Kao et al., DuoSkin: Rapidly Prototyping On-Skin User Interfaces Using Skin-Friendly Materials, ISWC'16

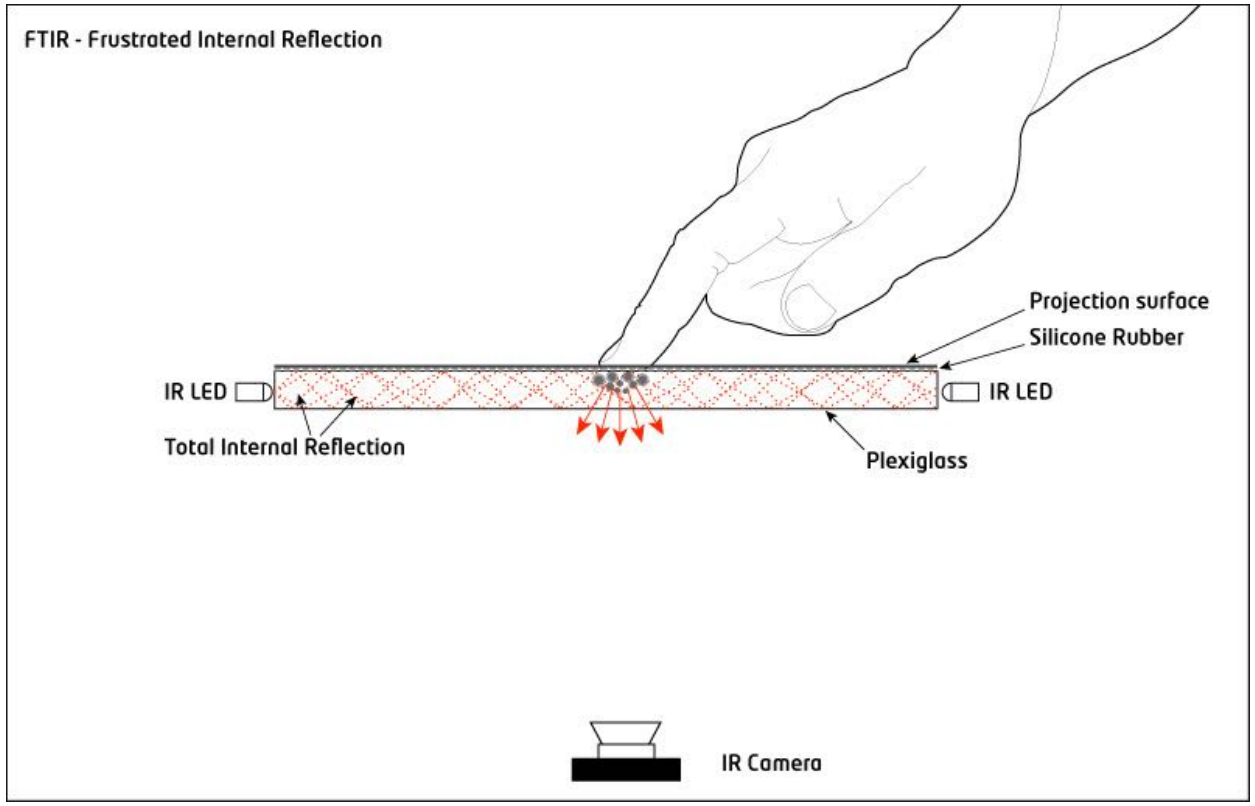
Camera-Based Touch Panels

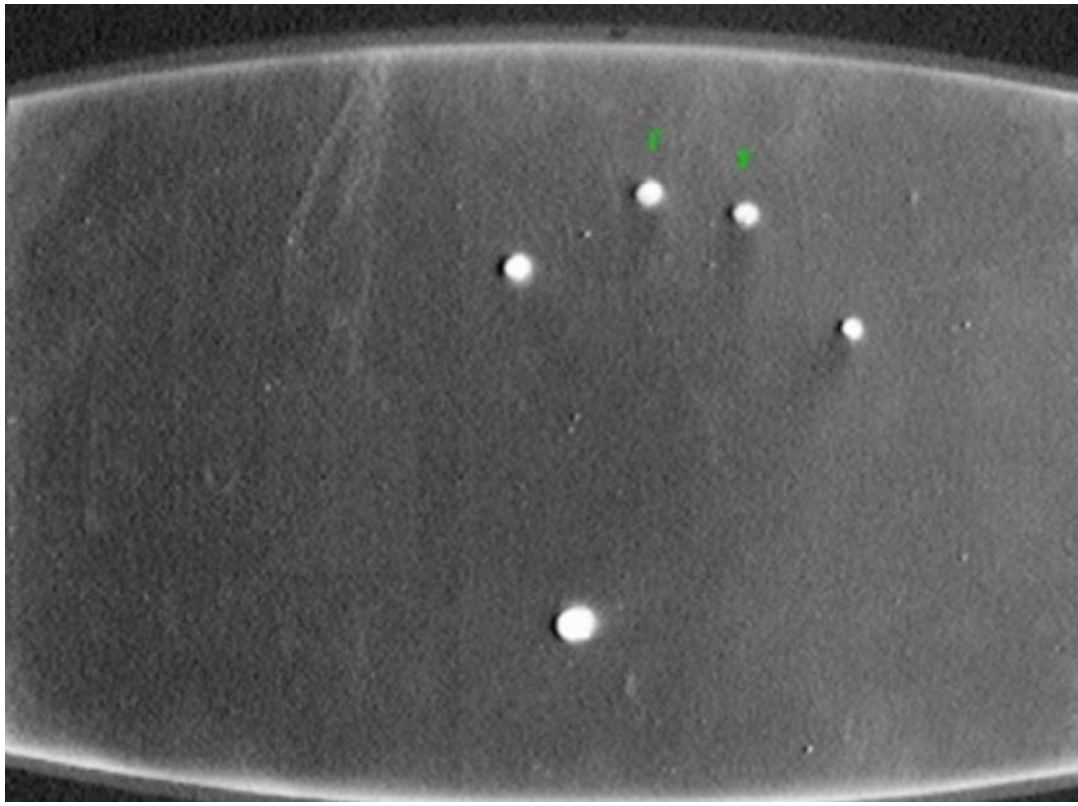
Diffused Illumination (DI) Method



Camera-Based Touch Panels

Frustrated Total Internal Reflection (FTIR) Method

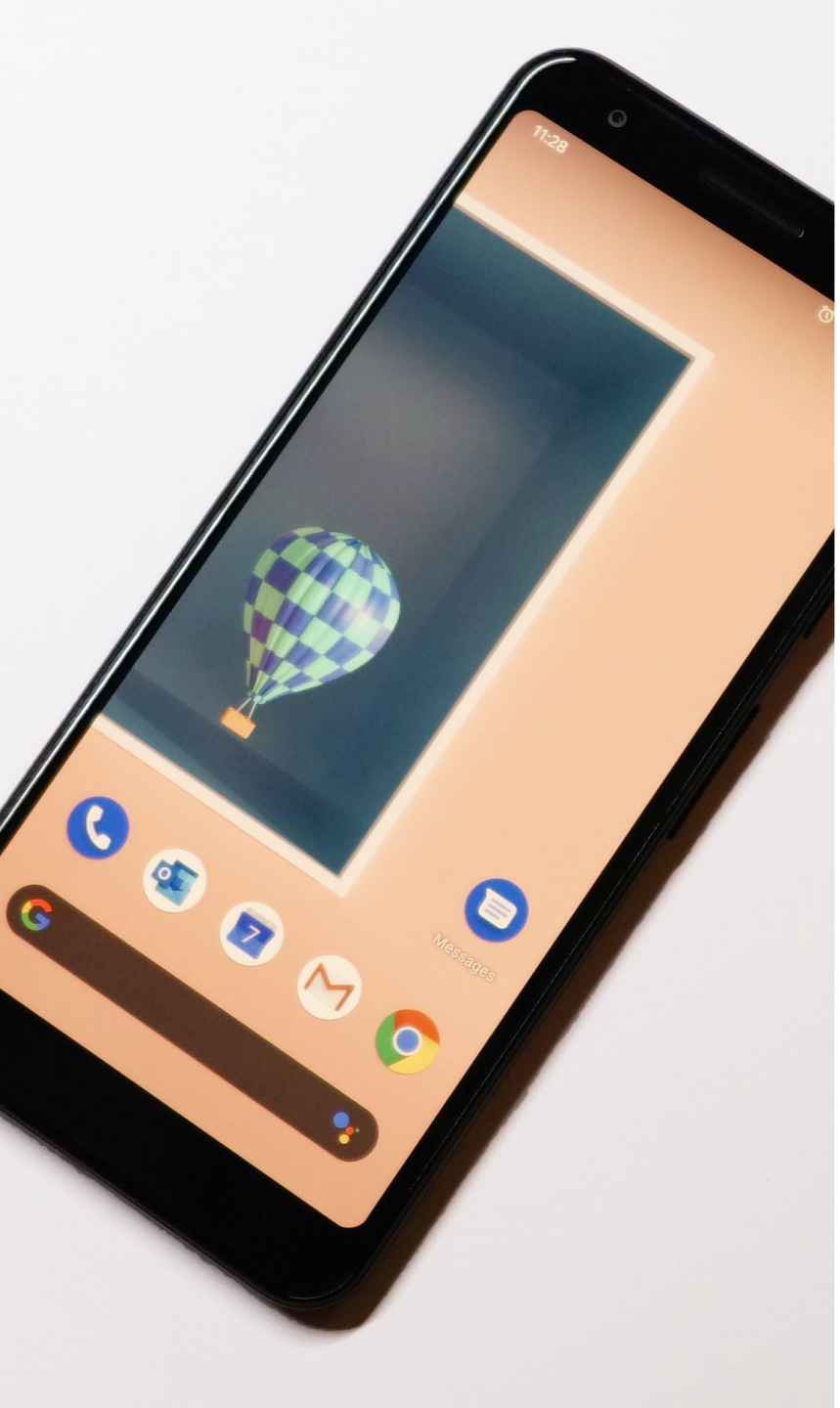


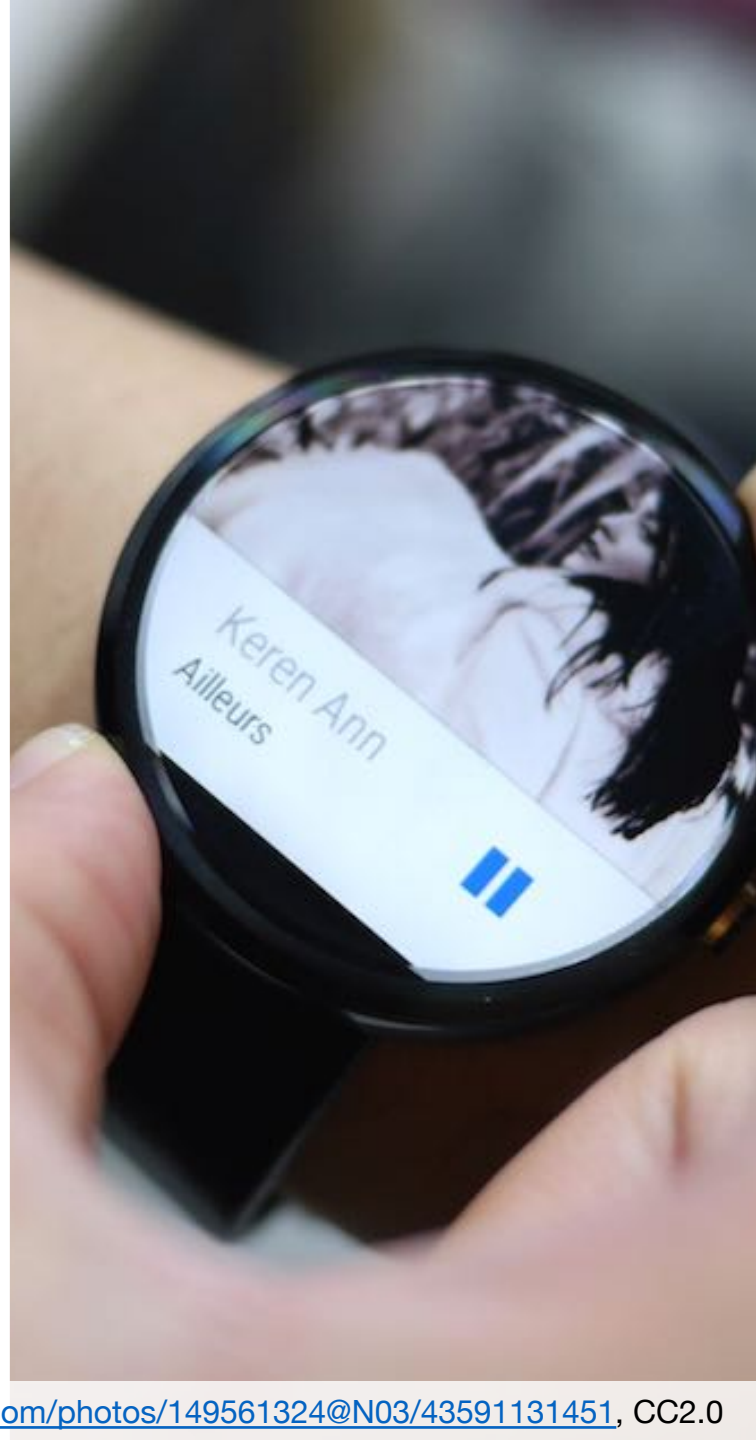


Camera-Based Touch Panels

- Pros
  - Can easily support multi-touch
  - Can detect contact shape
  - Can detect various objects
  - Easy to make large touch surfaces
- Cons
  - High error rate
  - Need large space underneath the surface due to the camera FOV

Microsoft PixelSense (2011) - discontinued



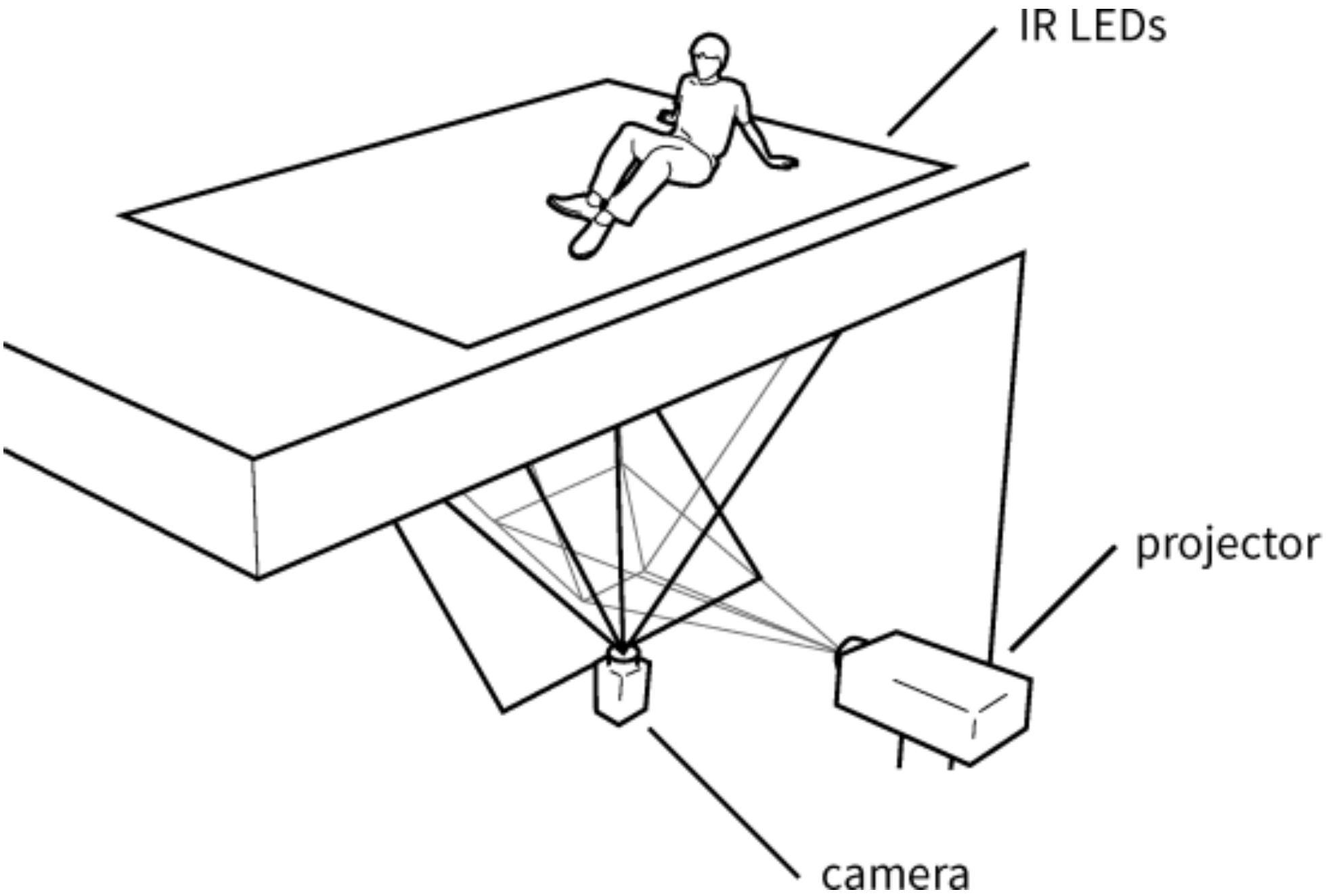


Are you happy with what you’re using?

Is it fast enough?

Jota et al. How fast is fast enough?: a study of the effects of latency in direct-touch pointing tasks. CHI 13

Is it big enough?

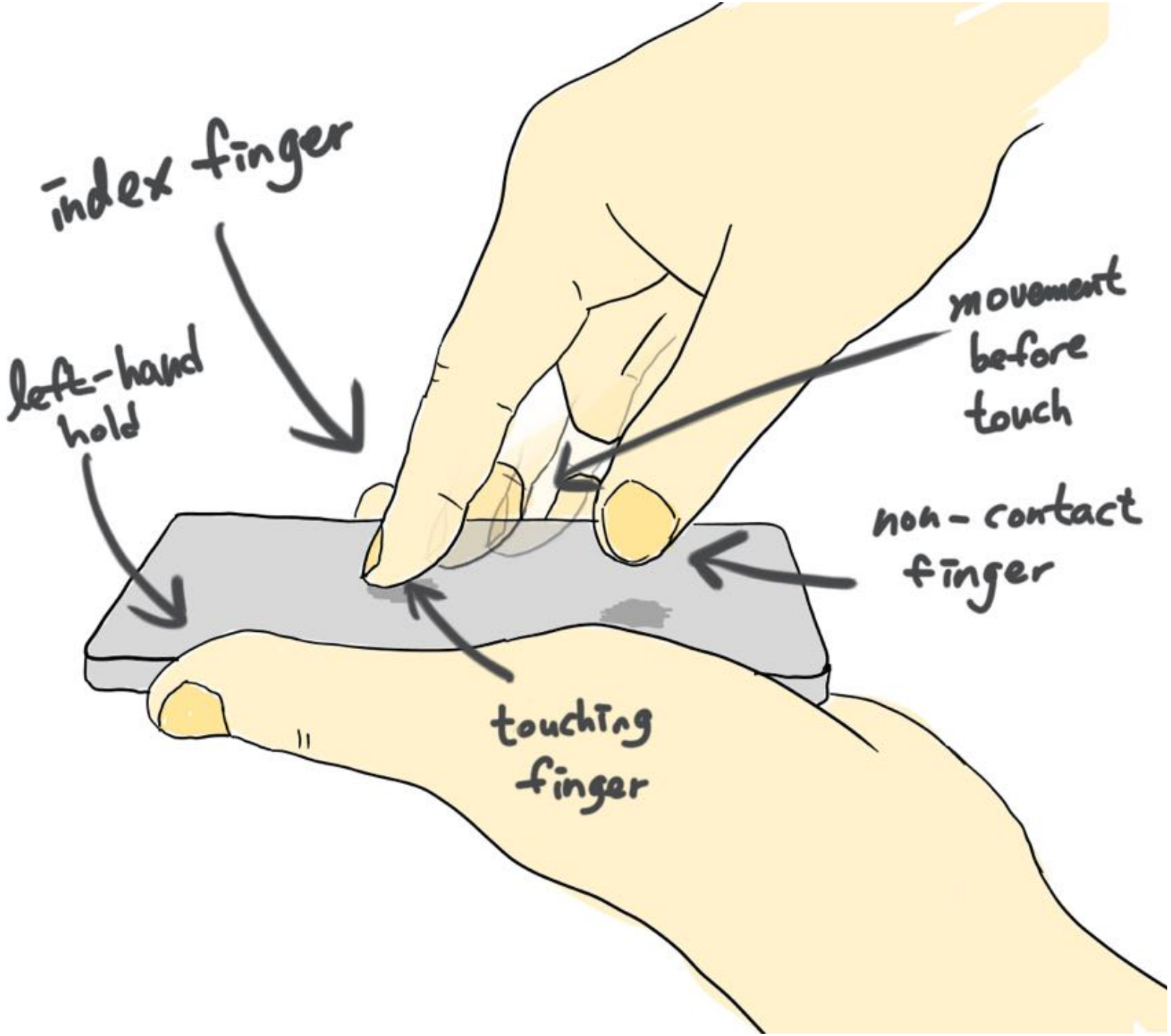


Bränzel, et al. GravitySpace: Tracking Users and Their Poses in a Smart Room Using a Pressure-Sensing Floor. CHI 2013

Fetzer et al. Multitoe: High-Precision Interaction with Back-Projected Floors Based on High-Resolution Multi-Touch Input. UIST 2010

Fetzer et al. Multitoe: High-Precision Interaction with Back-Projected Floors Based on High-Resolution Multi-Touch Input. UIST 2010

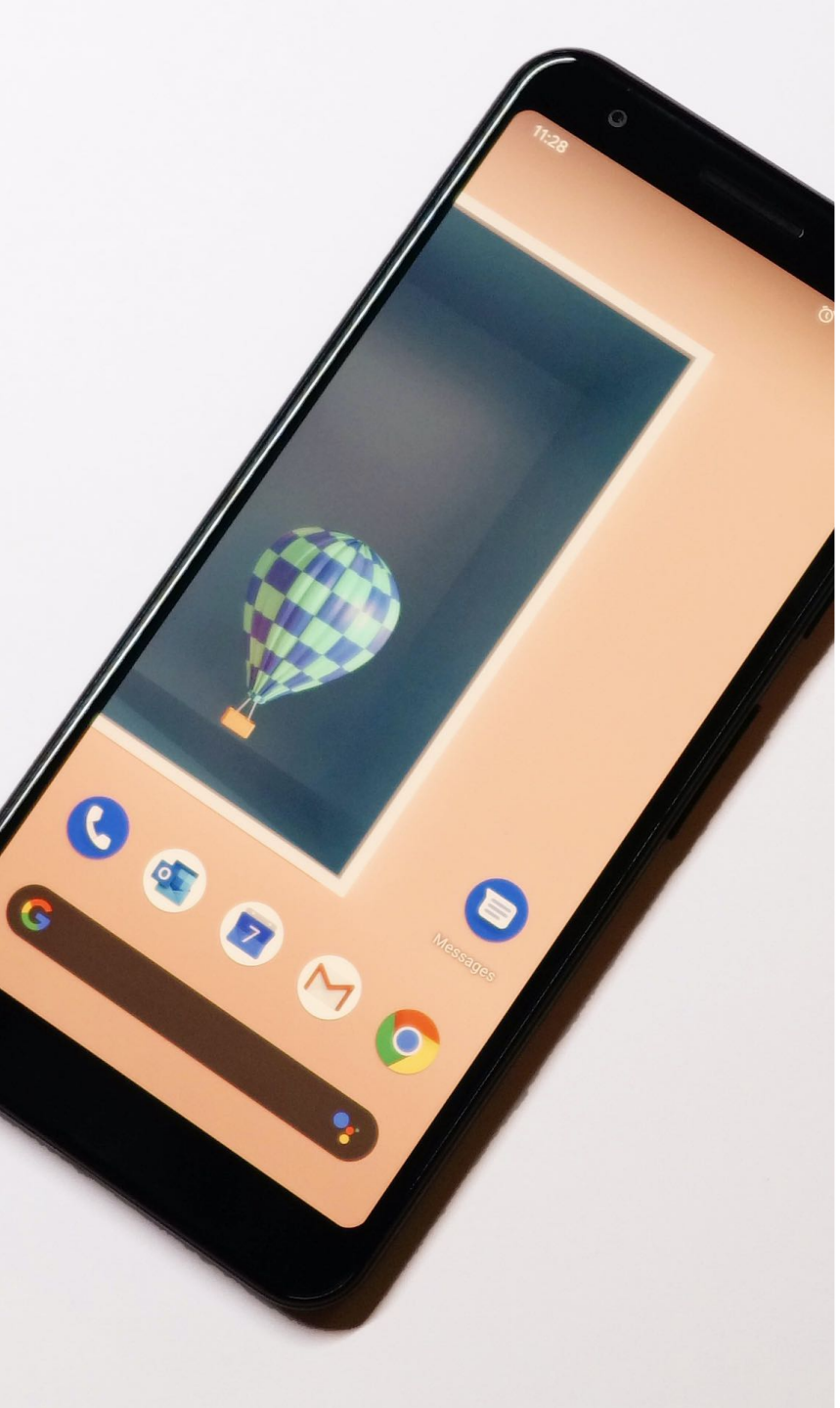
Is it sensitive enough?

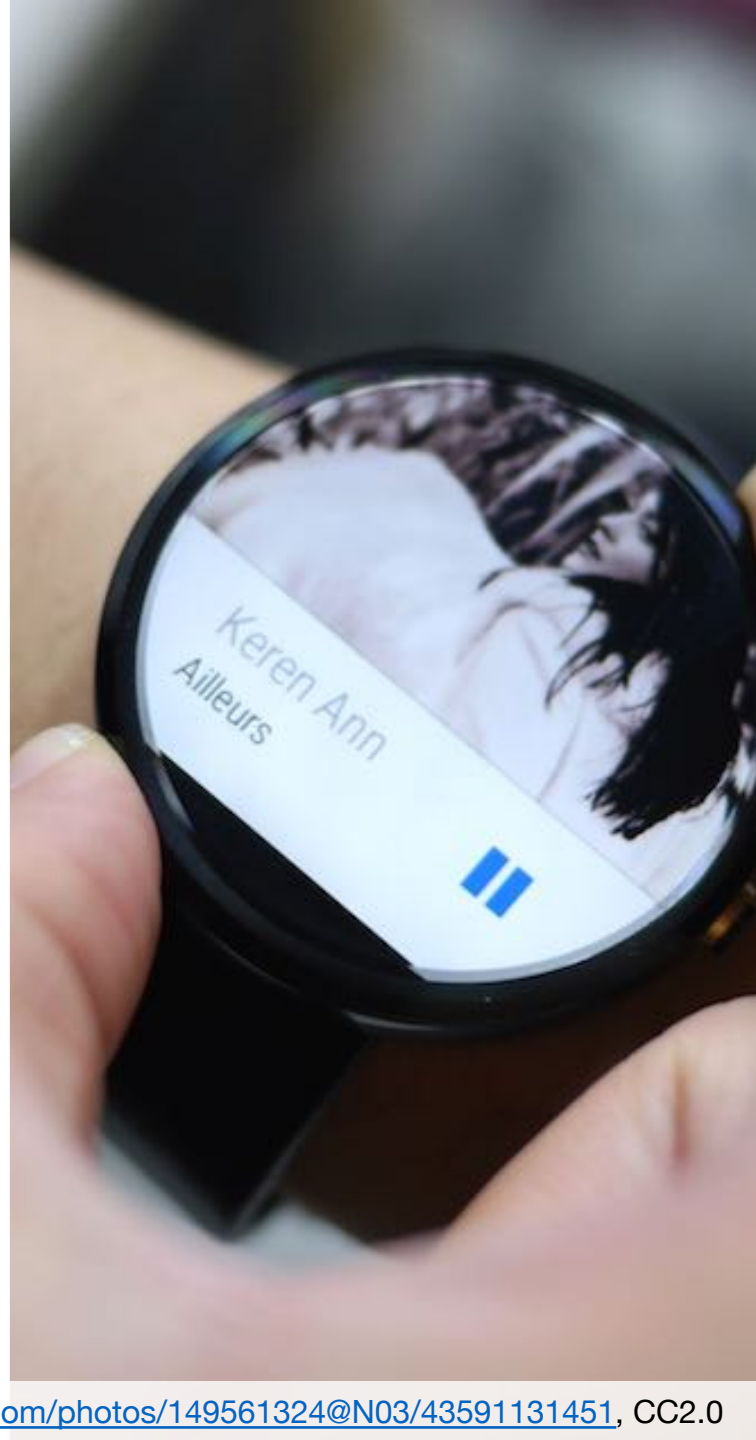

index finger
left-hand hold
movement before touch
non-contact finger
touching finger

Pre-Touch Sensing for Mobile Interaction

Ken Hinckley, Seongkook Heo, Michel Pahud,
Christian Holz, Hrvoje Benko, Abigail Sellen,
Richard Banks, Kenton O'Hara, Gavin Smyth, William Buxton

Microsoft Research





Thank you!