Mensch-Maschine-Interaktion 2

Hard- and Software for Interactive Surfaces

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Hardware for Interactive Surfaces

- (Visual) output: Display
  - quite well understood
  - simple solution: projection: front or back (or side ;-)
  - screens built into tables
  - modification of screen hardware
- Input: Sensing
  - much less well understood
  - many concurrent approaches, each with its drawbacks
  - categories: resistive, capacitive, optical, ...
  - wide field of ongoing research

Display: Front Projection

- what we are doing here in class
- simplest way to produce visual output on any surface
- pro:
  - cheap, simple
  - even light distribution
  - no additional space needed
  - space for legs under the table
- contra
  - interacting hand and person cast a shadow
  - only feasible for tabletops when firmly mounted

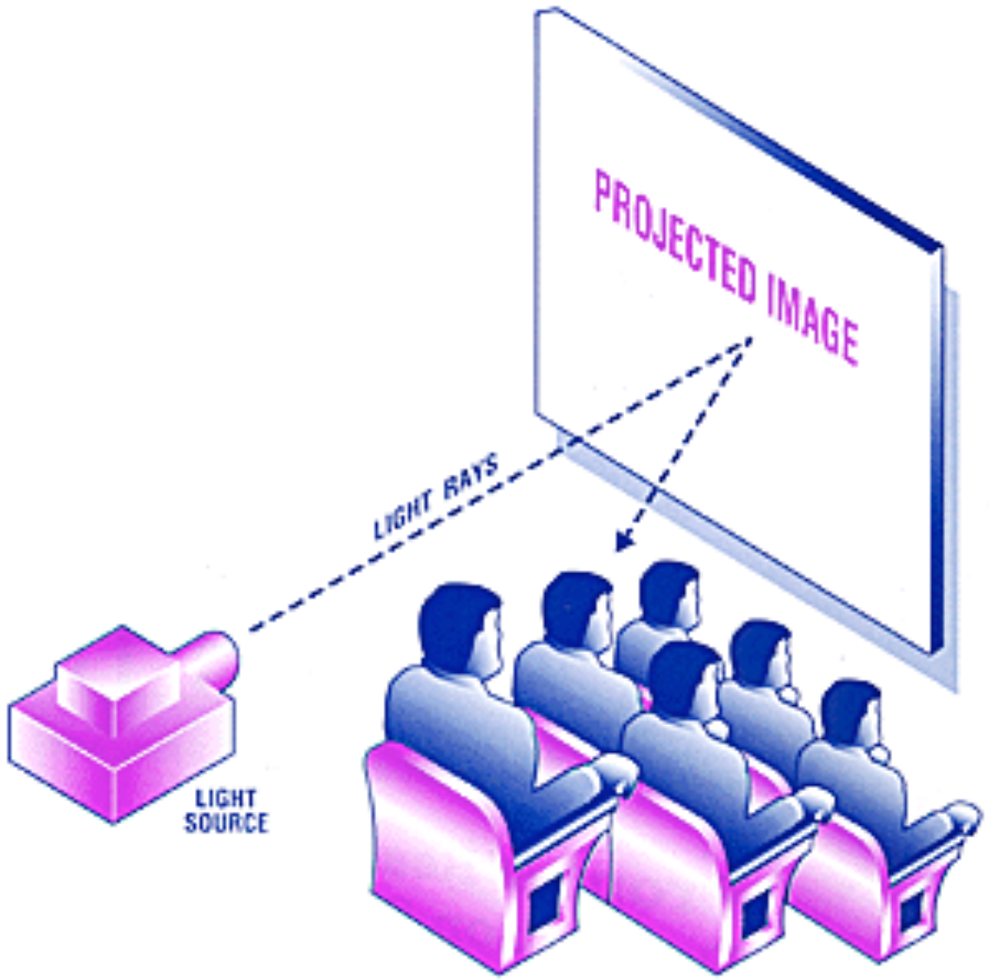
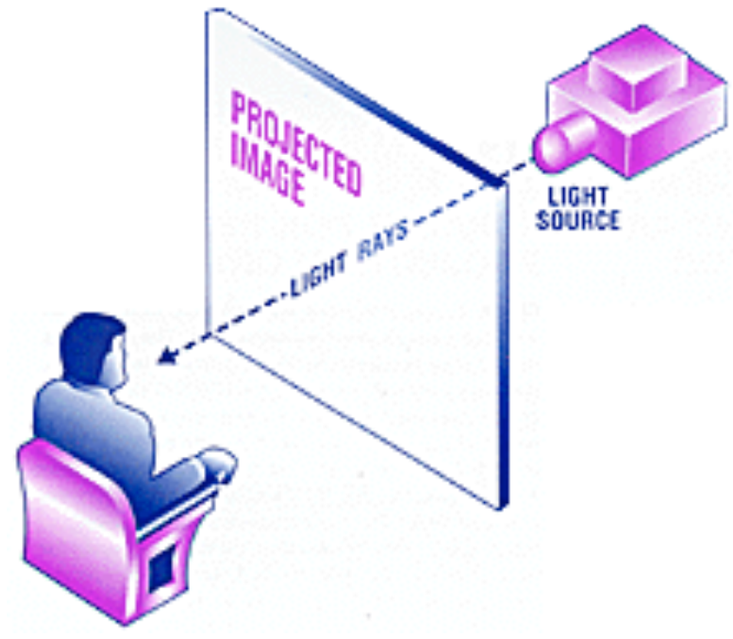


image source: http://www.rosco.com/

Display: Rear Projection

- Pro:
  - projector is hidden, space in front empty
  - no shadowing of the surface
- Contra:
  - Can only be done with space behind
  - complex mirror construction for tabletops
  - can create „hot spot“ with cheap screen



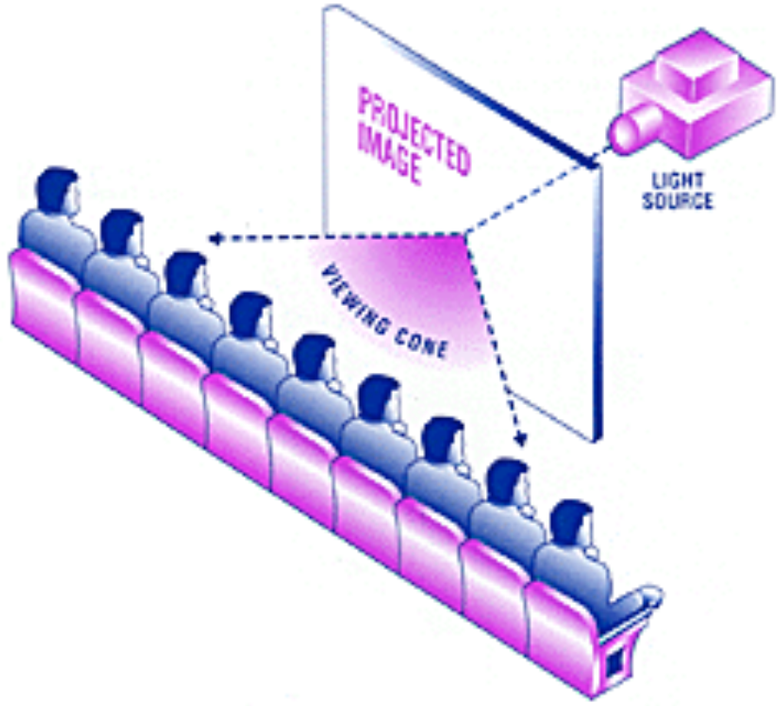
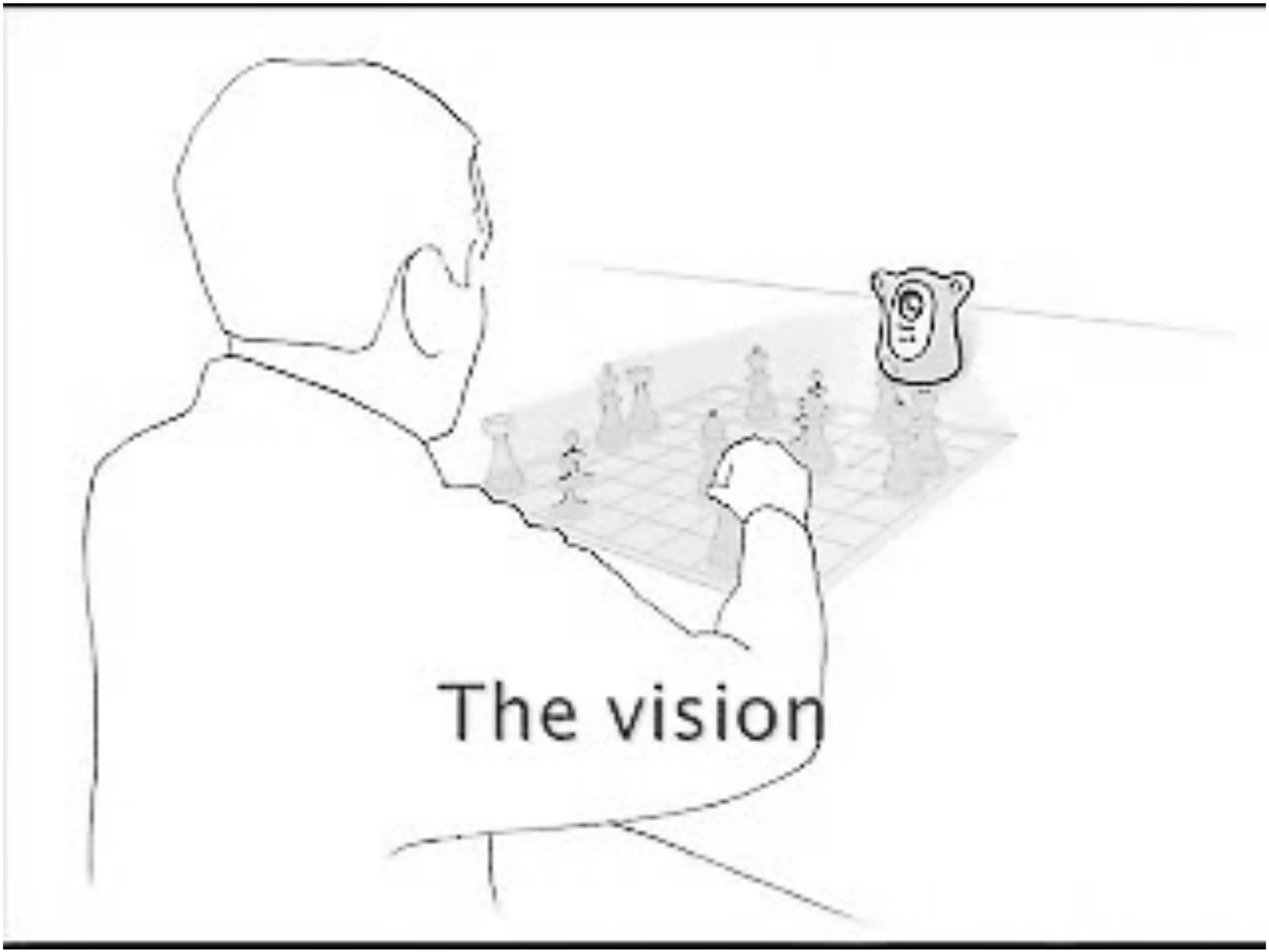


image source: http://www.rosco.com/

Display: Projection from the side ;-)

- PlayAnywhere, Andy Wilson (Microsoft Research), 2005
- Uses commercial short throw projector for front projection at an angle of 40 degrees
- Uses cameras for sensing
  - mounted off axis from the projection
  - can see shadows caused by front projection
  - can recognize fingers and markers
- Turns any flat surface (e.g., table) into an interactive surface

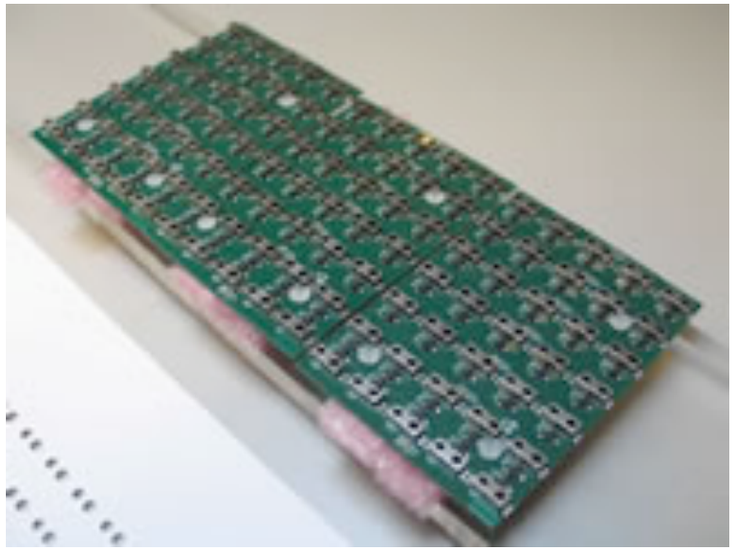

The vision

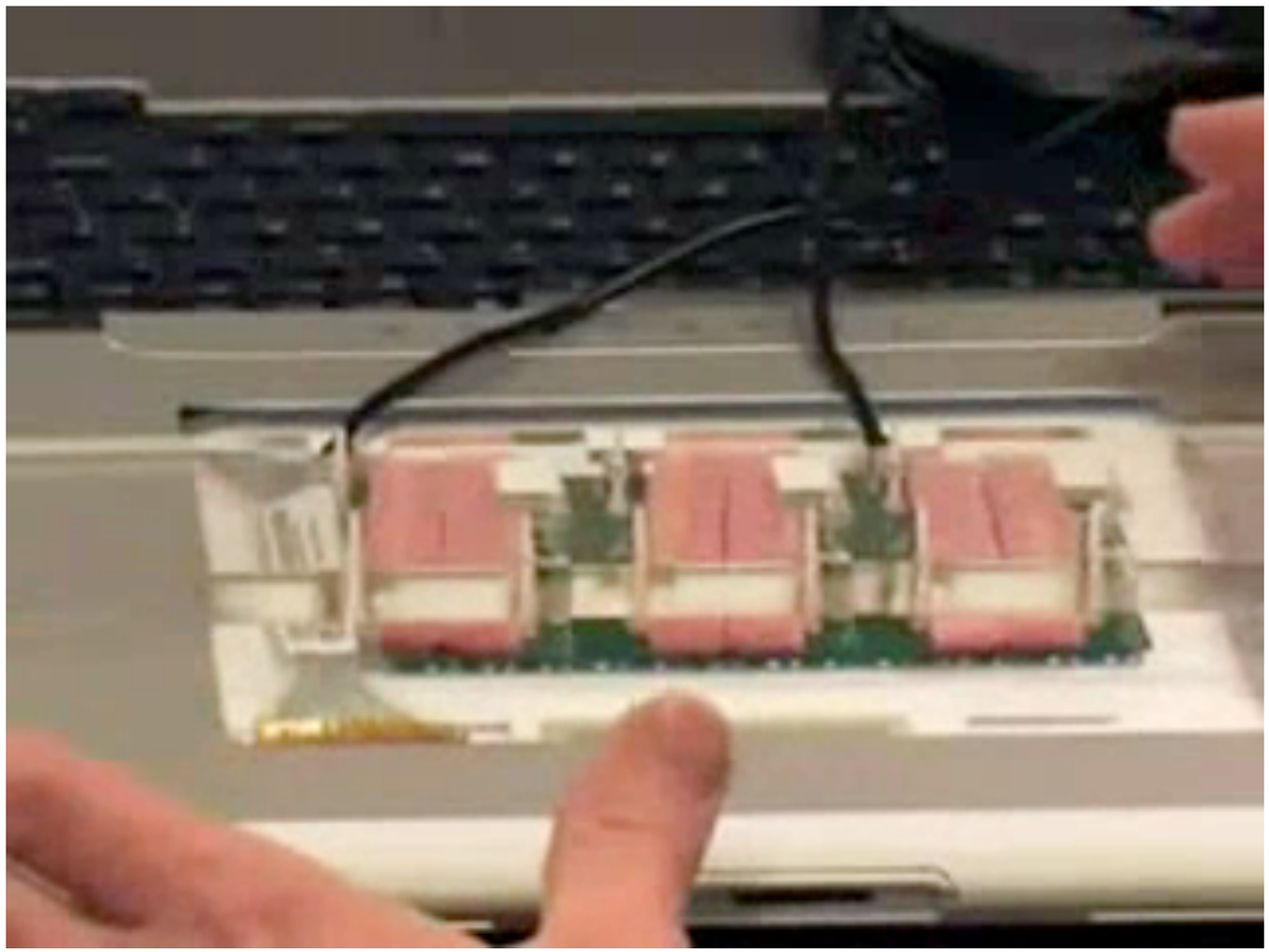
Display: Screens

- What we initially used in our tabletop research @LMU
  - High resolution and contrast + great color
  - Insensitive to ambient light
  - Can be bought with touch overlay for sensing

Screen with integrated sensing: ThinSight

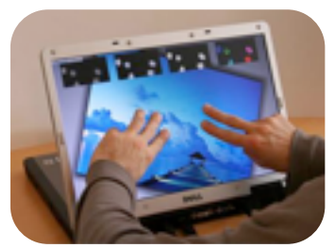
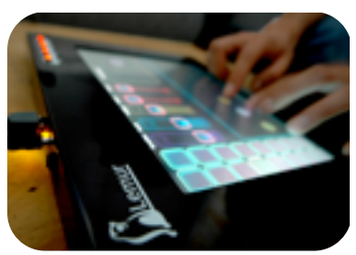
- Izadi (Microsoft Research), 2007
- Shines IR light through LCD from the back
- Mesures Reflection from objects or fingers
- low resolution prototype
- senses simple gestures
- could turn display into a scanner/camera

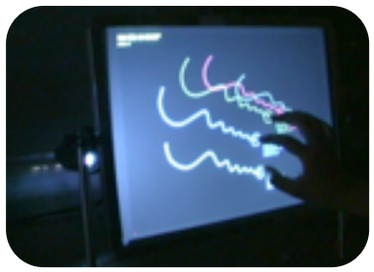


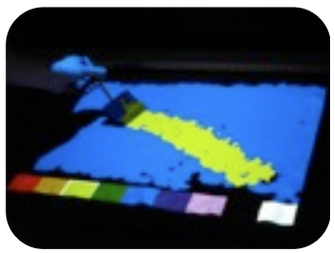


Sensing

- Embedded sensors
  - Capacitive
  - Resistive
  - Optical
- Camera Infrared
  - FTIR
  - Diffuse Illumination
- Others

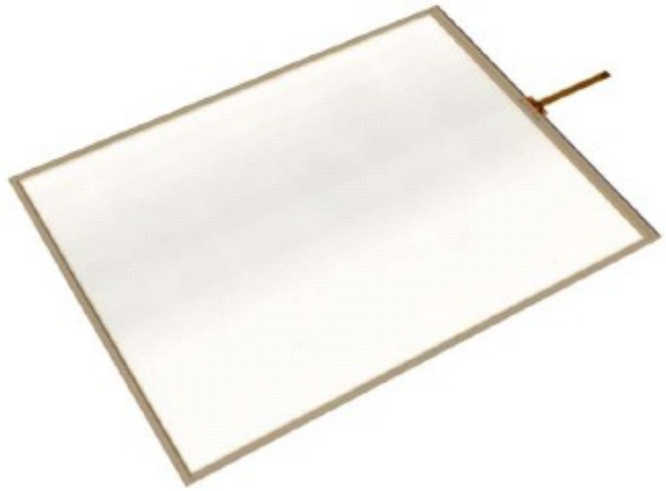




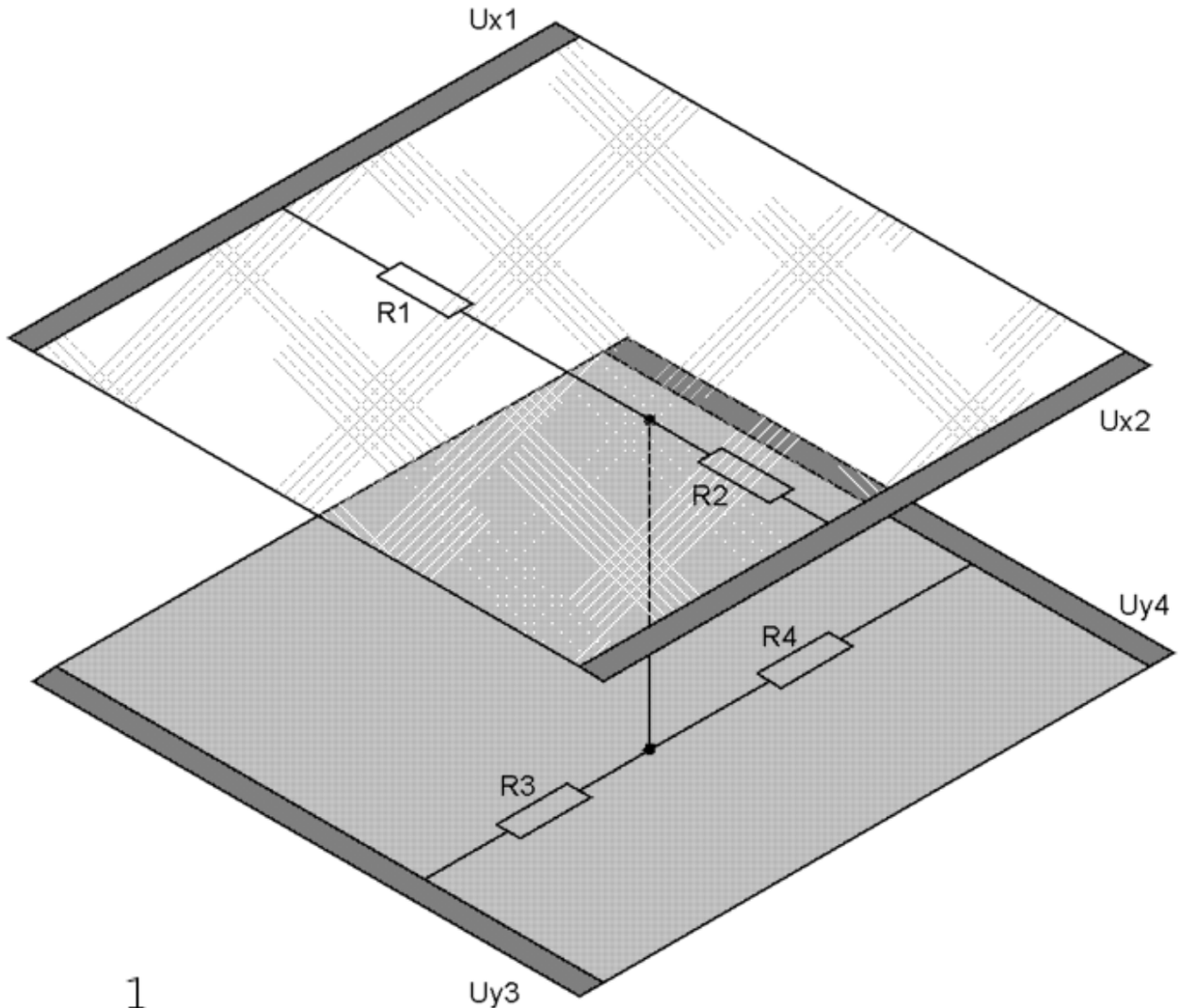


Classical touch screen

[http://de.wikipedia.org/wiki/Touchscreen]



- Two sheets of conductive, transparent material
- Connected by finger or pen pressure
- Resistance measurements
  - Between X electrodes
  - Between Y electrodes



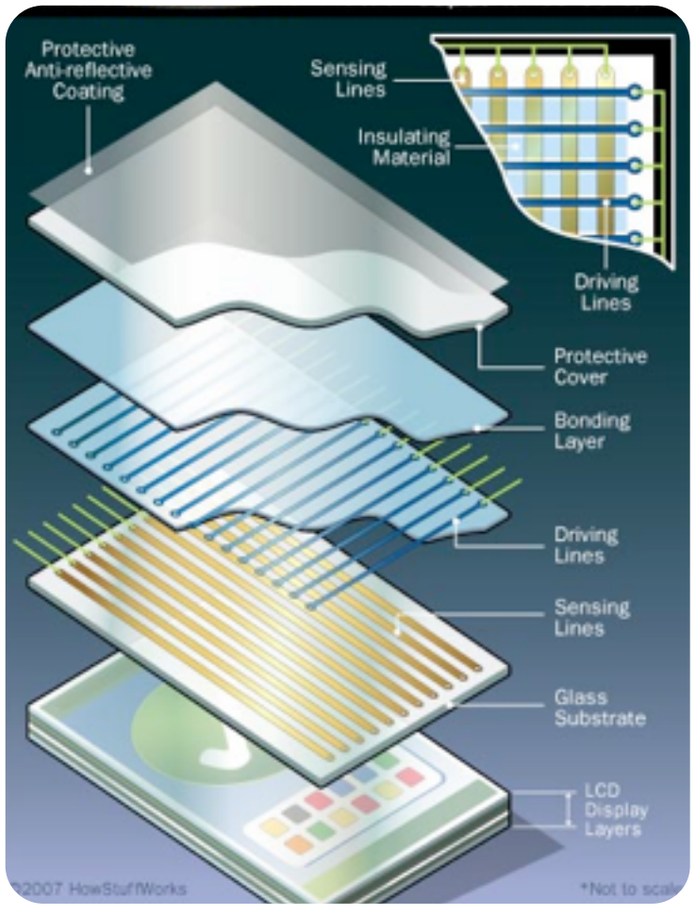
$$Uy_3 = Uy_4 = Ux_2 + \frac{(Ux_1 - Ux_2) * R_2}{R_1 + R_2} = 0V + 5V * \frac{1}{3} = 1,66V$$

Capacitive Sensing

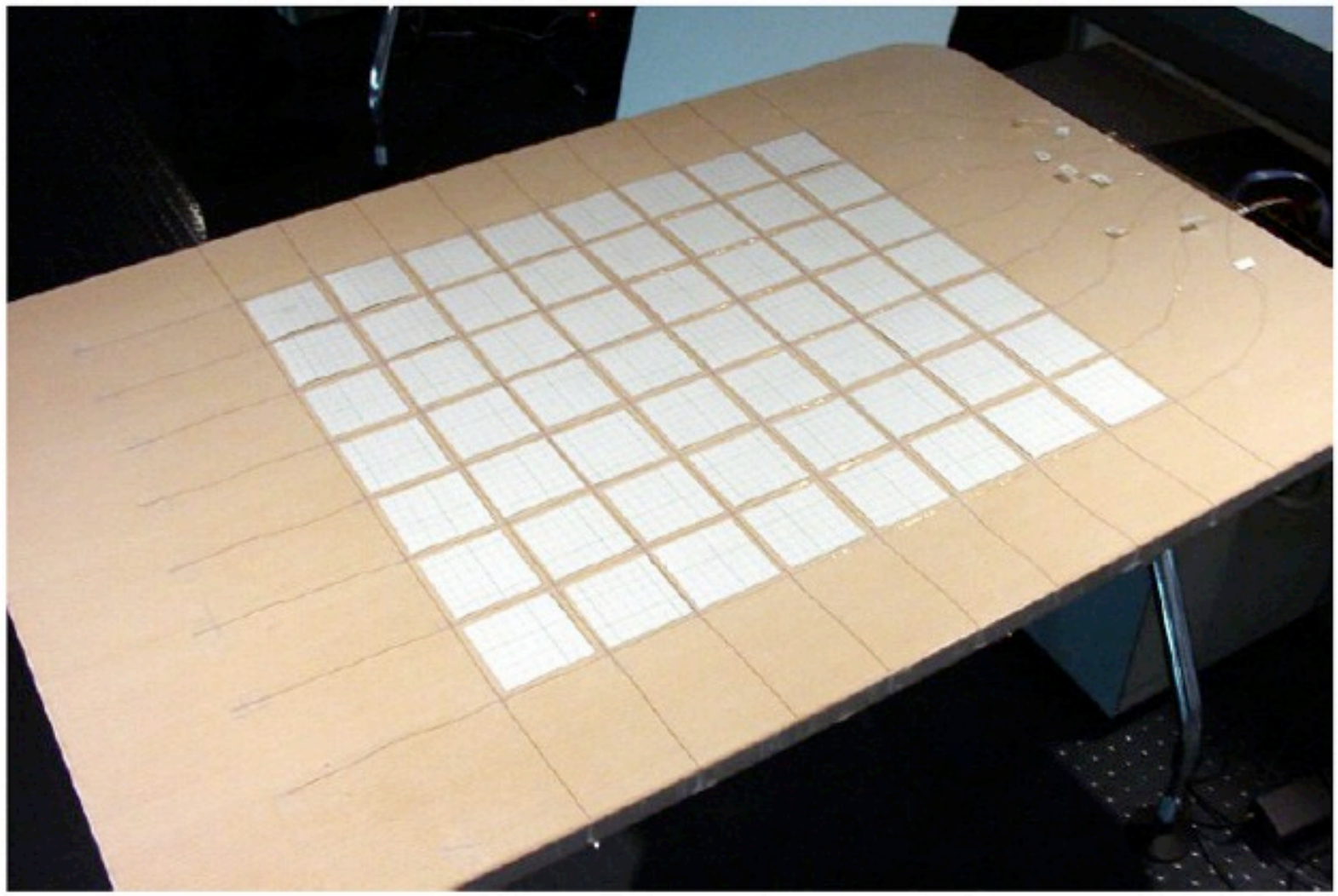
- Layer of conductive material holds charge
- Finger approaching the surface changes the amount of charge
- requires grid of driving and sensing lanes
- OR individual electrodes embedded in one layer

[Dietz Leigh'01]

[Rekimoto'02]



Capacitive Sensing: Sony SmartSkin



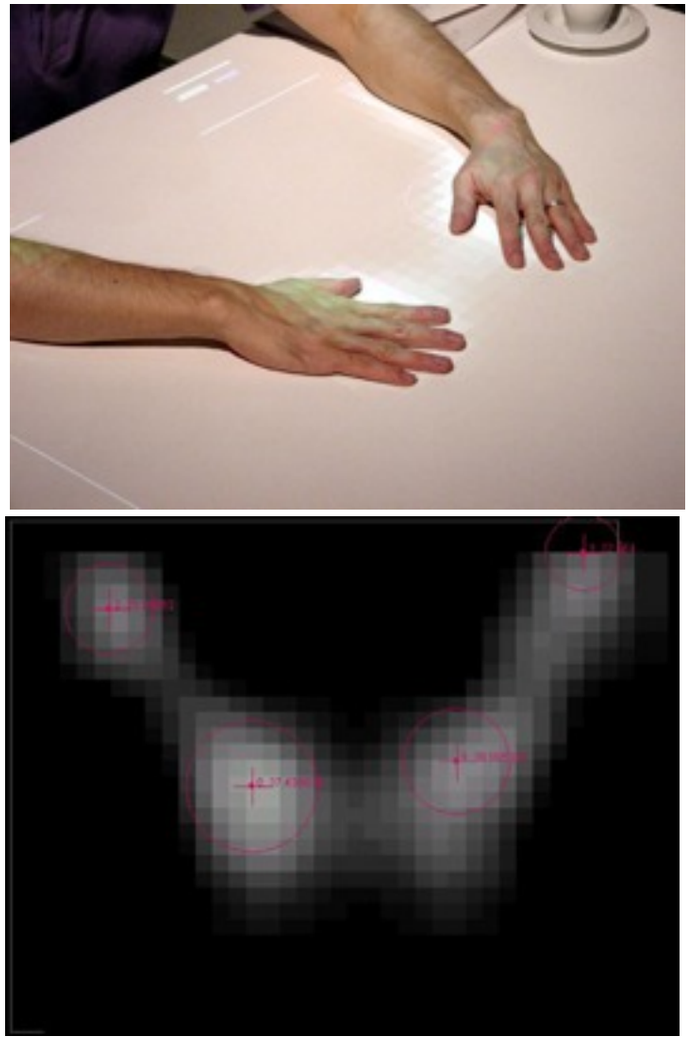


Figure 3: Interactive table with an 8 × 9 SmartSkin sensor: A sheet of plywood covers the antennas. The white squares are spacers to protect the wires from the weight of the plywood cover.

Capacitive Sensing: Sony SmartSkin

- finger only changes capacitive coupling in grid

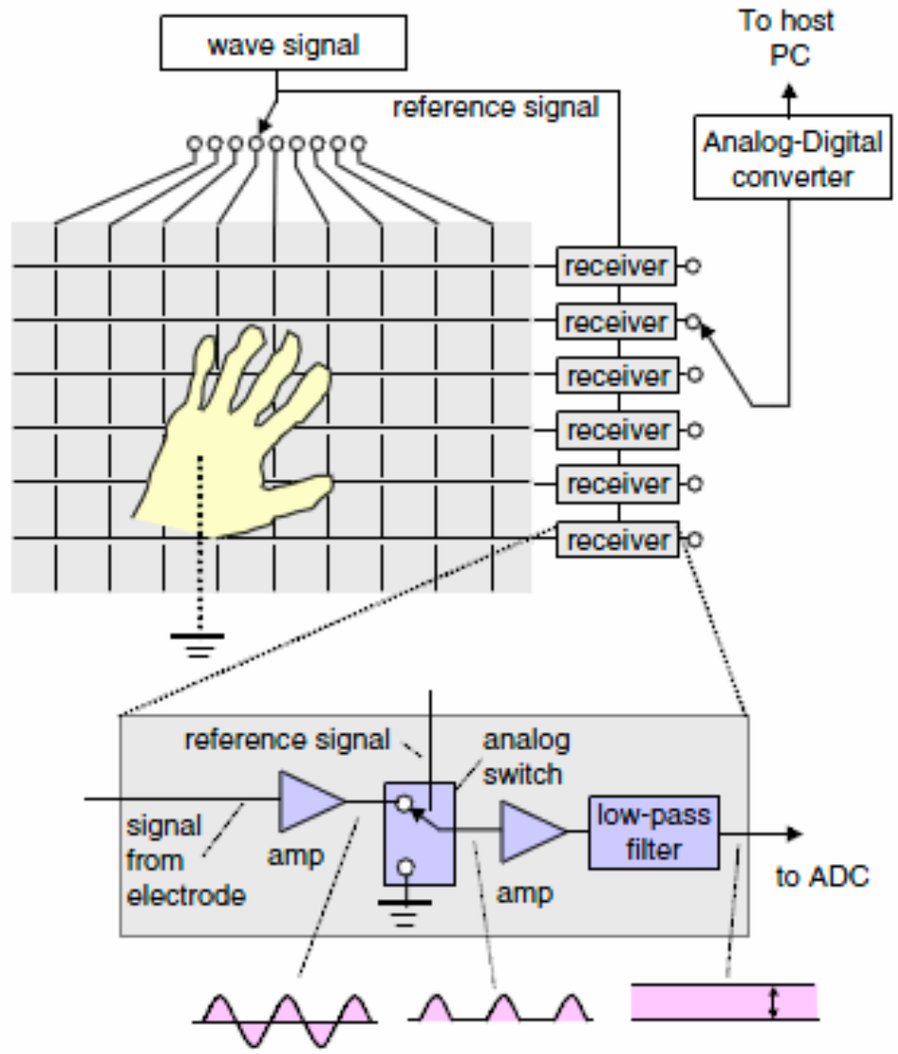


Figure 2: The SmartSkin sensor configuration: A mesh-shaped sensor grid is used to determine the hand's position and shape.

Capacitive Sensing: MERL DiamondTouch

- finger acts as one electrode of the capacitor
- connection e.g., through the chair
- different users send different signals
- finger identification solved!!

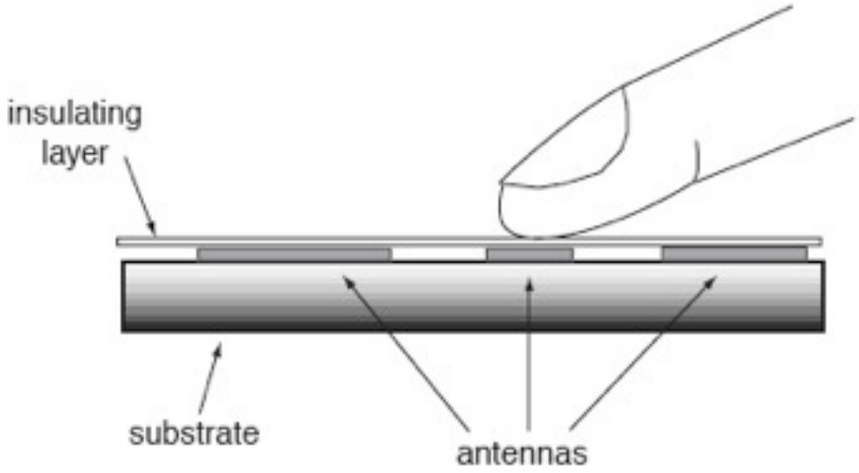
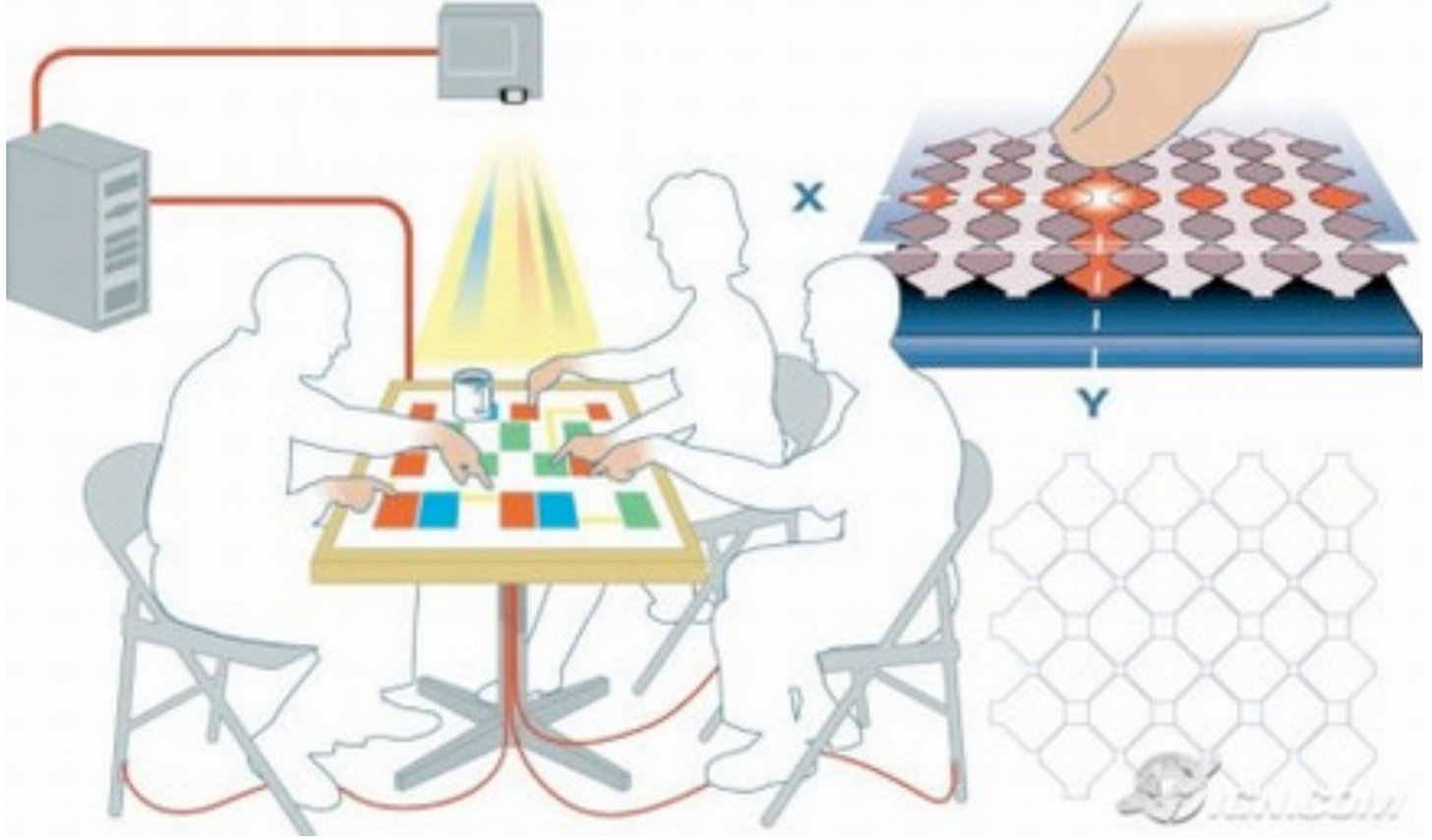
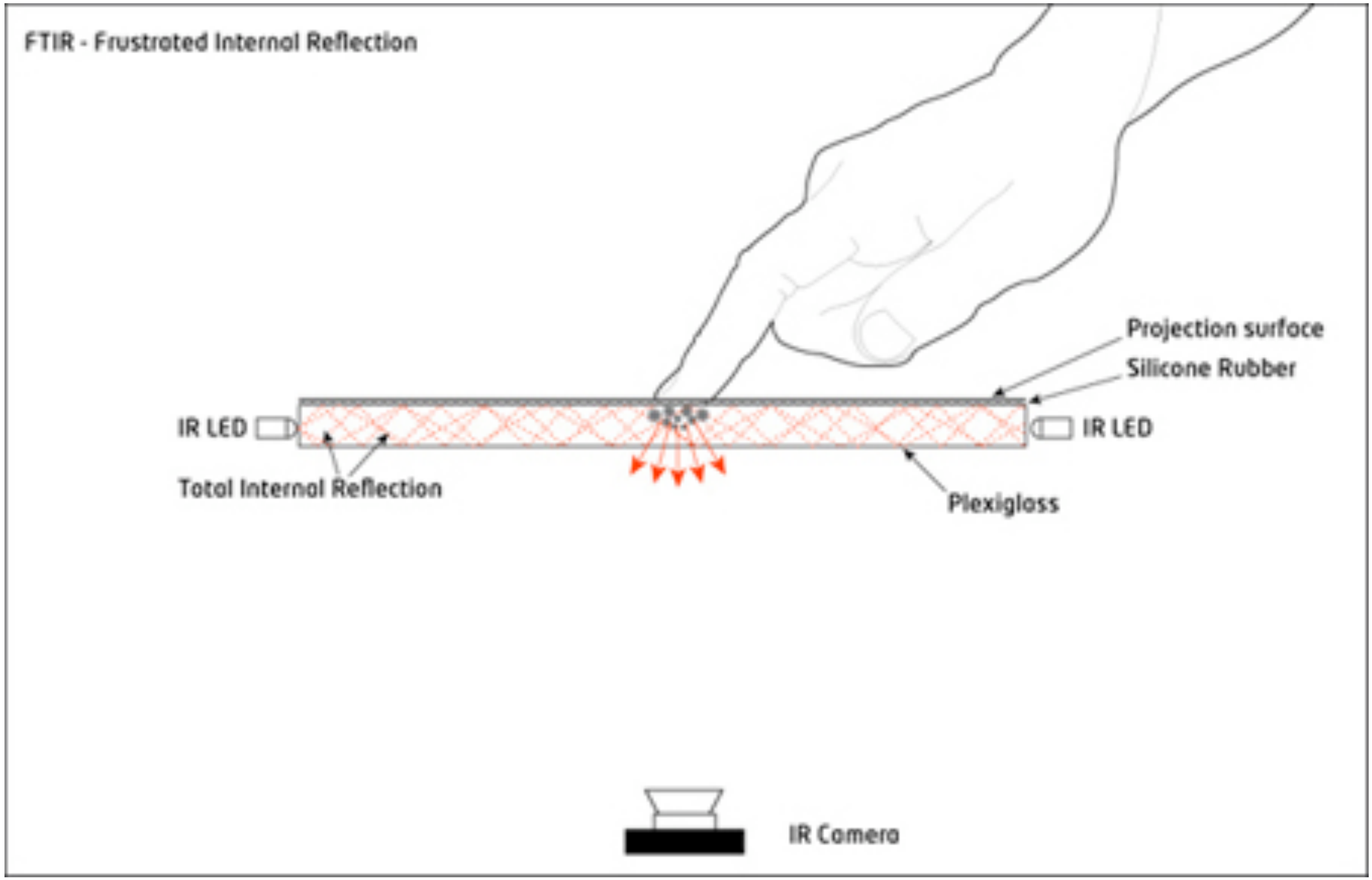


Figure 3: A set of antennas is embedded in the table-top. The antennas are insulated from each other and from the users.

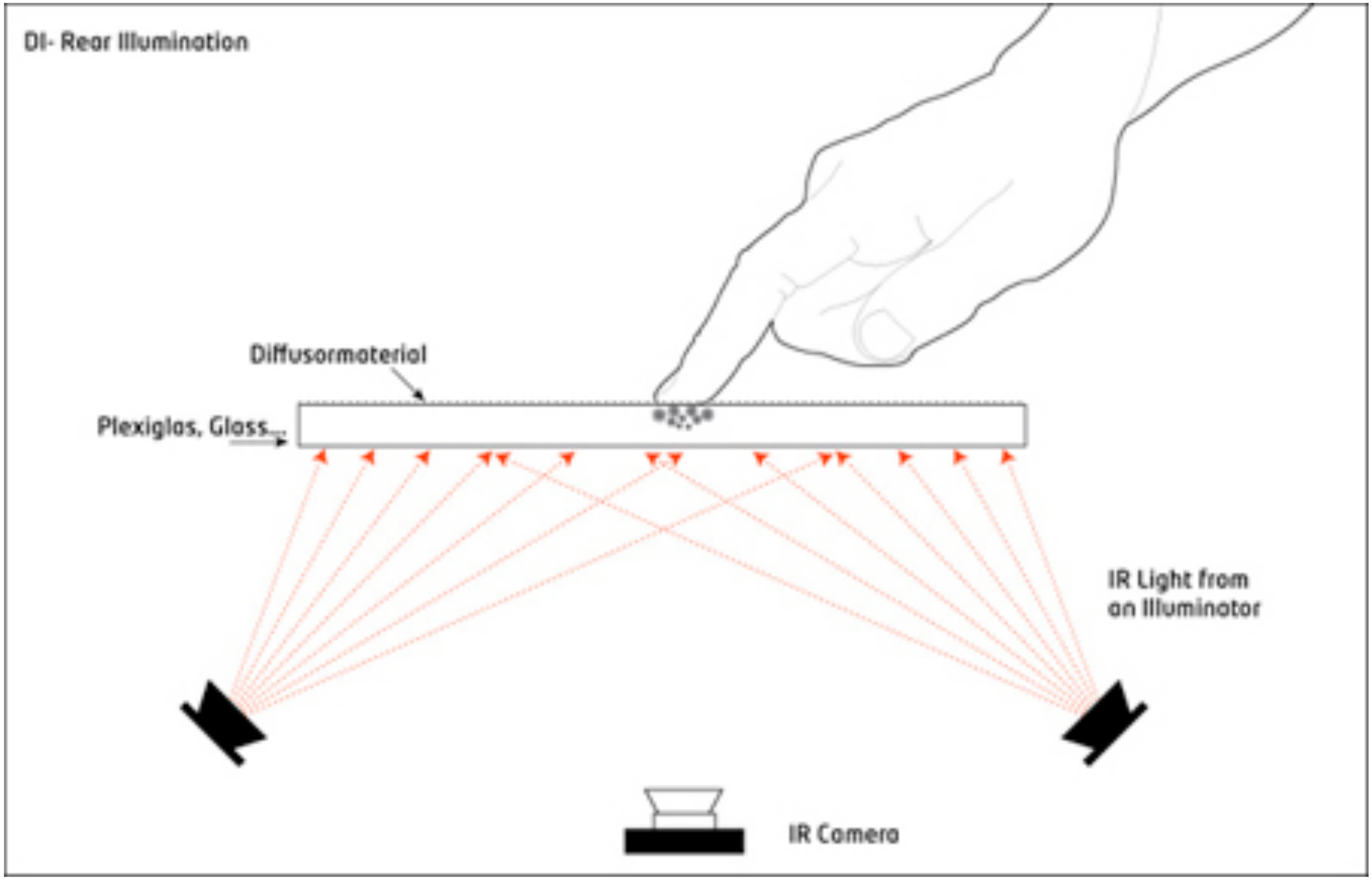


Optical Sensing - FTIR



http://iad.projects.zhdk.ch/multitouch/

Optical Sensing - DI



http://iad.projects.zhdk.ch/multitouch/

TouchLight

- Andy Wilson, ICMI 2004
- Projection onto Holofilm (transparent projection screen)
- imaging through the screen ==> funny effects possible

Optical tracking from the side: SmartTech SmartBoard DViT

Figure 1: DViT Technology Camera

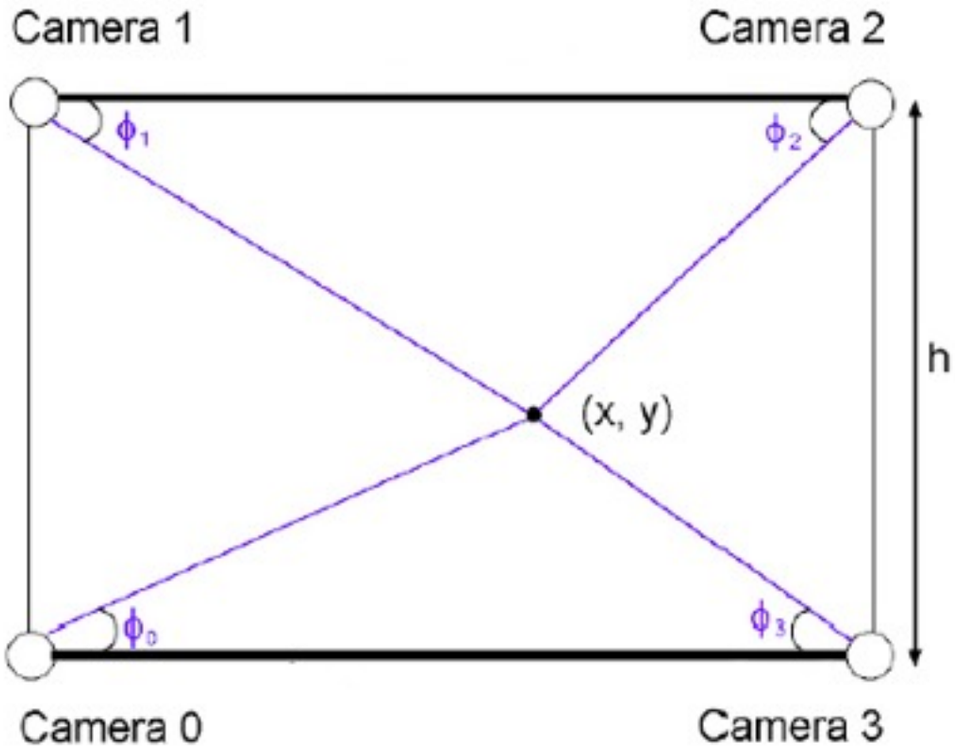
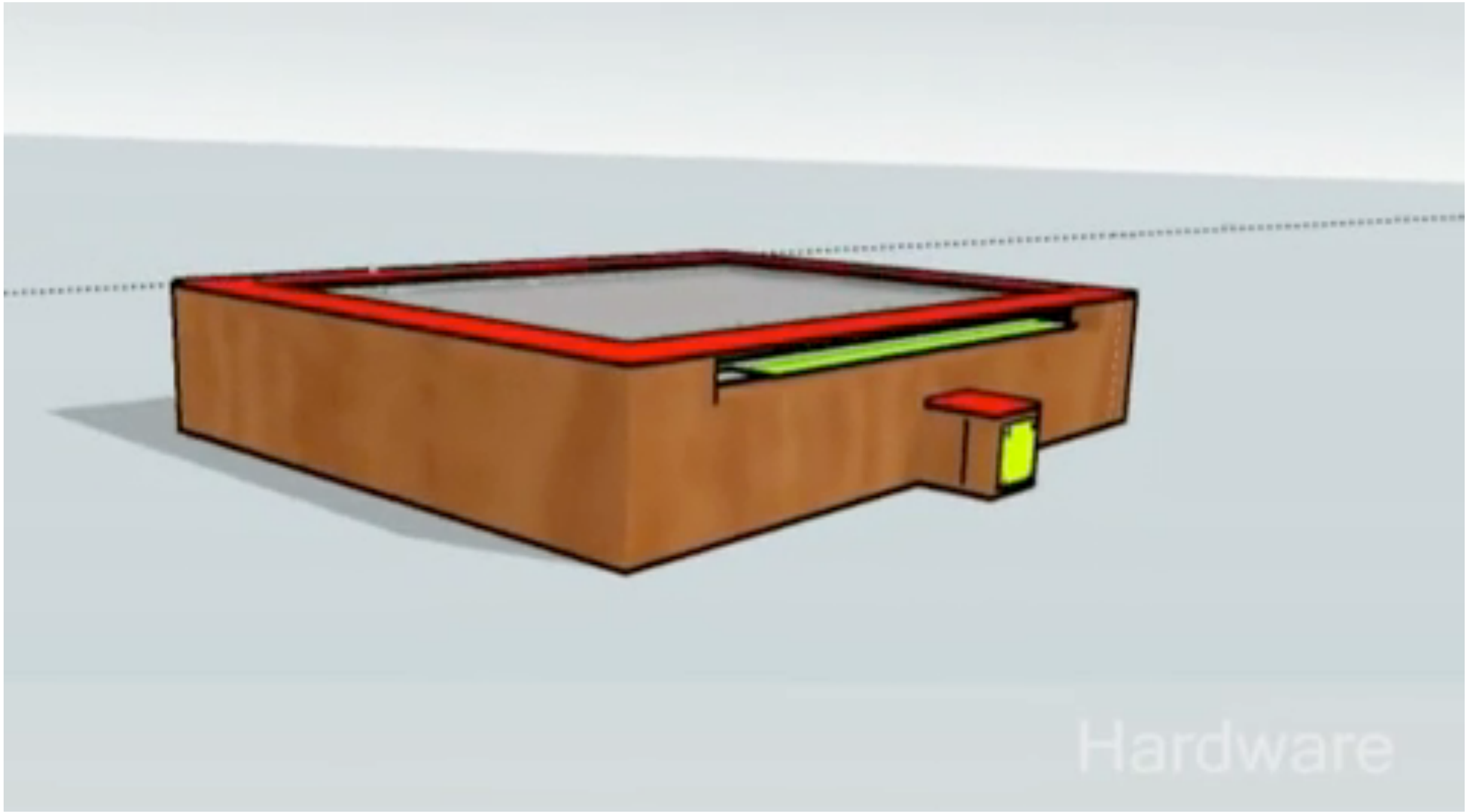


Figure 2: Camera Identification of a Contact Point

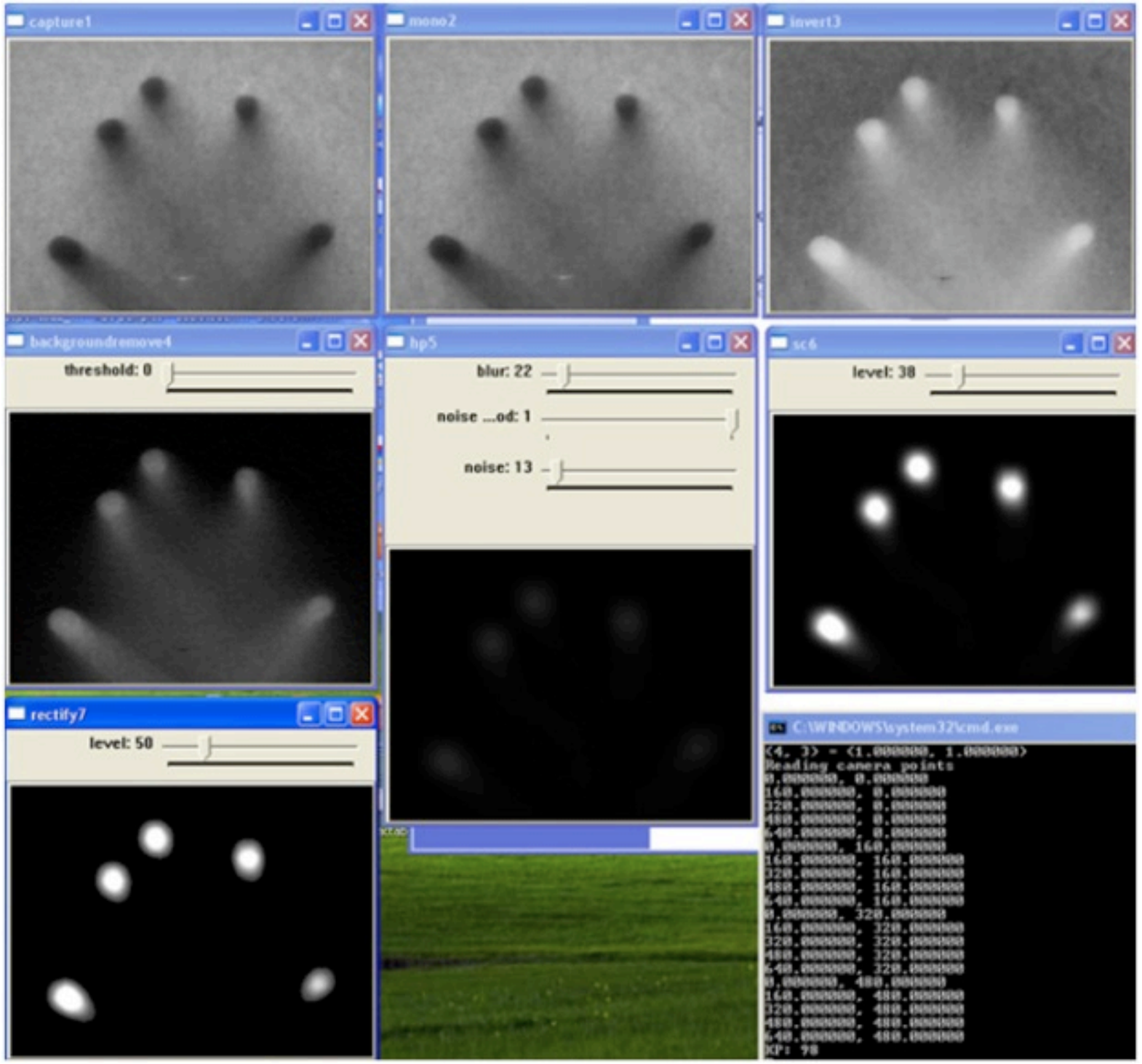
- 4 cameras, 100FPS
- can be overlaid to screens, projection surfaces etc..
- theoretically 4, practically 2 (narrow) contact points
- http://www.smarttech.com/dvit/index.asp

Optical Tracking twisted: Fiberboard



Multitouch DIY project for the weekend!

http://sethsandler.com/multitouch/mtmini/



Commercial and semi-OTS Interactive tables

- MS surface http://www.microsoft.com/surface/
- Interactable http://www.ipsi.fraunhofer.de/ambiente/english/projekte/projekte/ineractable.html
- SmartTable http://www2.smarttech.com/st/en-US/Products/SMART+Table/
- Reactable http://www.reactable.com/
- Lemur http://www.jazzmutant.com/

Microsoft Surface

PHYSICAL DIMENSIONS

Surface unit including display and housing (L x W x H)

42.5 x 27 x 21 inches/108 x 69 x 54 cm

With metal panels: 180 pounds/82 kg
Available in U.S. and Canada only

With acrylic panels: 198 pounds/90 kg

Shipping pallet and container (L x W x H)

49 x 34 x 32.5 inches/124.5 x 86 x 82.5 cm

Pallet, box, foam: 80 pounds/36 kg

TECHNICAL SPECIFICATIONS

Display

- Type: 30-inch XGA DLP® projector
- ATI X1650 graphics card with 256 MB of memory
- Maximum resolution: 1024 x 768
- Lamp mean-life expectancy: 6,000+ hours
- Maximum pressure on the display: 50 pounds per square inch/3.5 kg per cm
- Maximum load: 200 pounds

Input Devices

- Camera-based vision system with LED infrared direct illumination

Computing System

- 2.13-GHz Intel® Core™ 2 Duo processor
- Memory: 2 GB dual-channel DDR2
- Storage: Minimum 250 GB SATA hard-disk drive

Network Protocols and Standards

- Network adapter: Intel Gb LAN
- Wireless LAN connectivity supported: Yes
- Networking and Data Protocols: IEEE802.11b, IEEE802.11g, Bluetooth 2.0, Gigabit Ethernet

I/O Connections

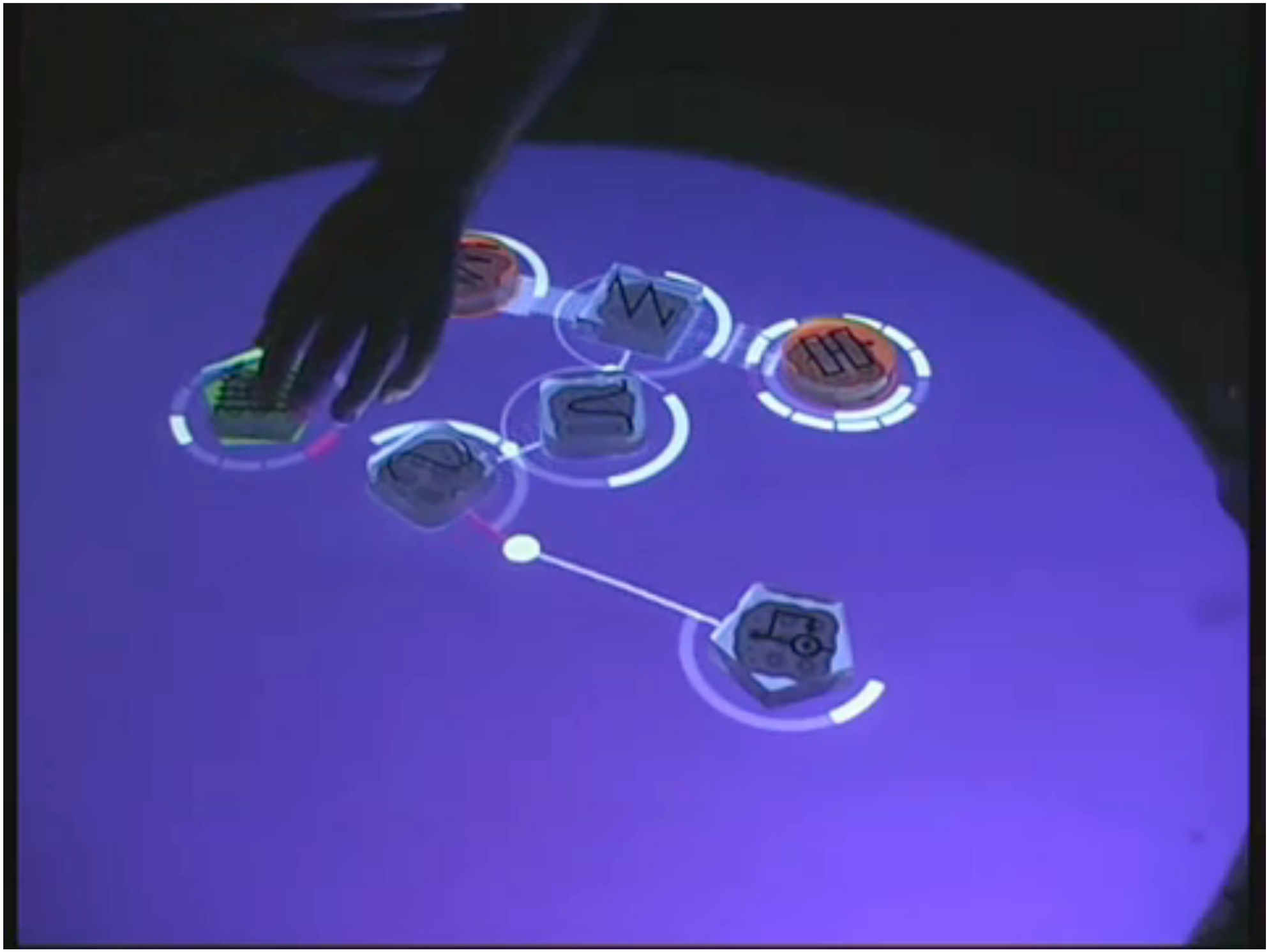
- 2 headphone jacks
- 6 USB 2.0 ports
- RGB component video
- S-VGA video (DB15 external VGA connector)
- Component audio
- Ethernet port (Gigabit Ethernet card [10/100/1000])
- External monitor port
- Bays for routing cables
- On/Standby power button

FhG Interactable

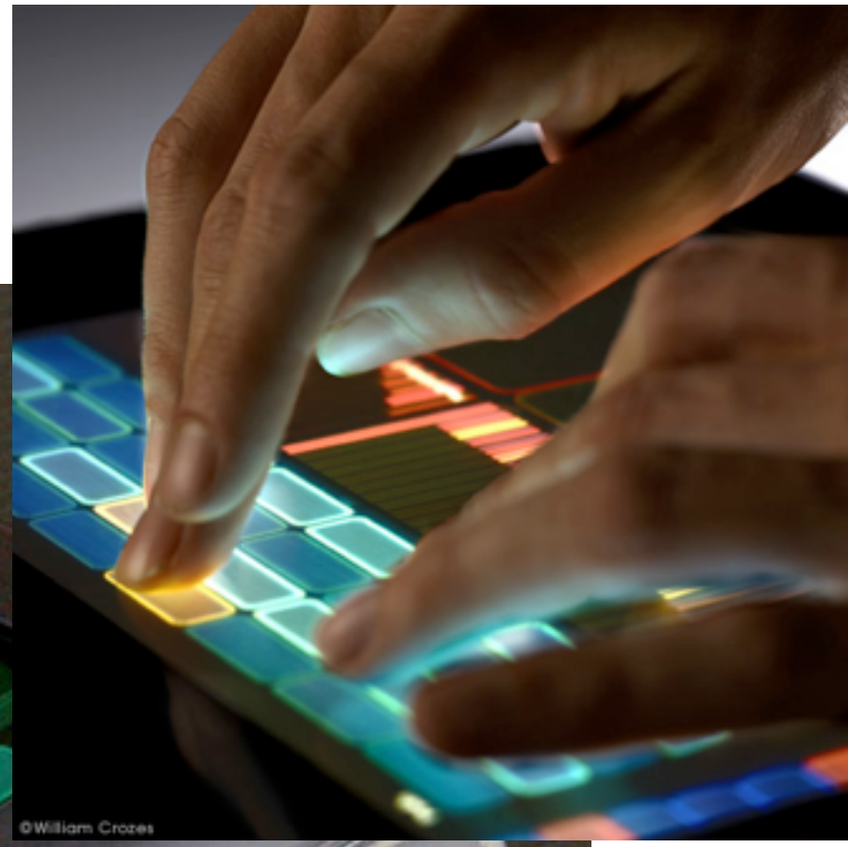
- The new InteracTable® is 90 cm high with a display size of 70 cm x 125 cm. The horizontal workspace is realized with a touch-sensitive plasma-display (PDP) which is integrated into the table top of the InteracTable.
- People can use pens and fingers for gesture-based interaction with information objects. The IT components are mounted below. The margin of the table surface can be used to lean on it and to place additional material or coffee cups and the like.
- SmartTech DViT sensing: dual touch

SMART Technologies SmartTable

Reactable



Jazzmutant Lemur

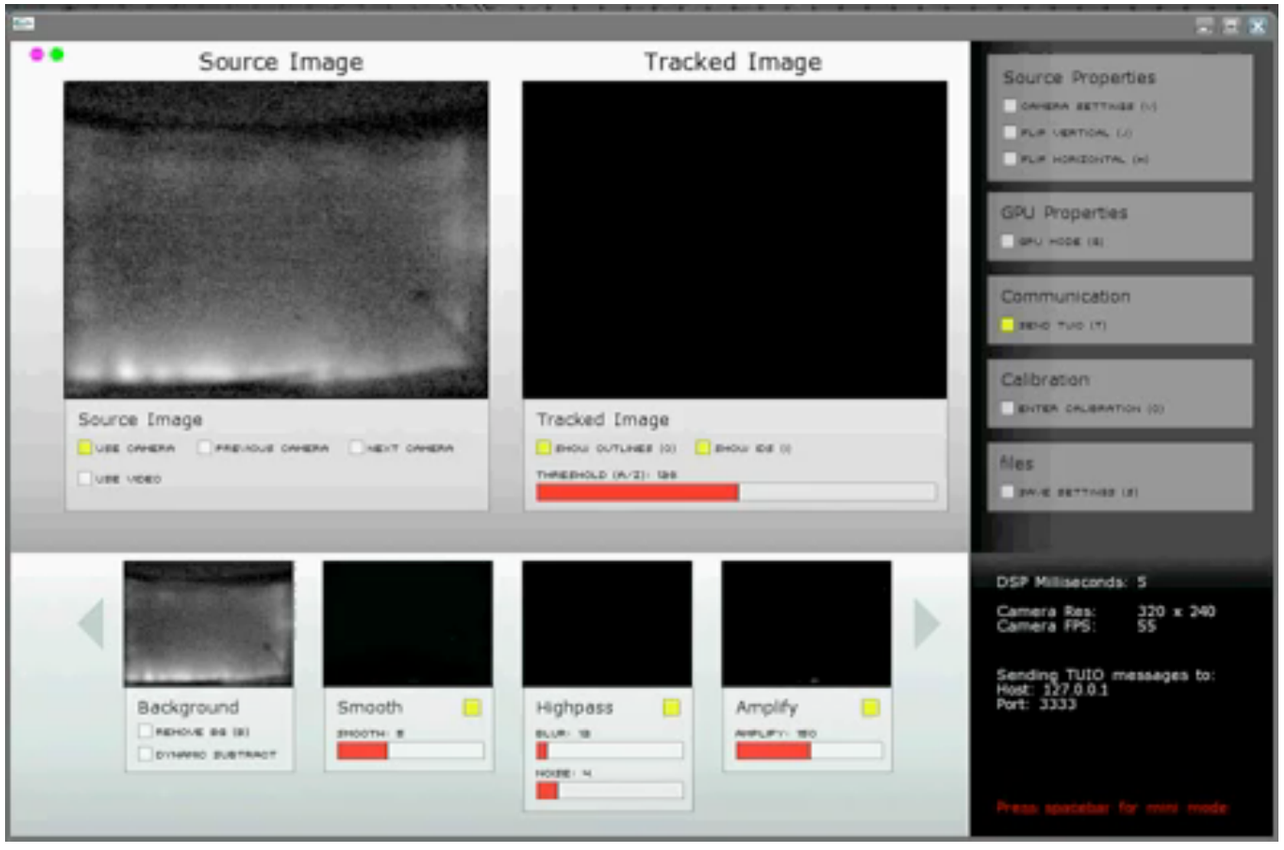


Software for Interactive Surfaces

- Touchlib http://nuigroup.com/touchlib/
- Reactivision http://reactivision.sourceforge.net/
- the TUIO protocol http://www.tuio.org/
- Squidy http://www.squidy-lib.de/

Touchlib and CCV

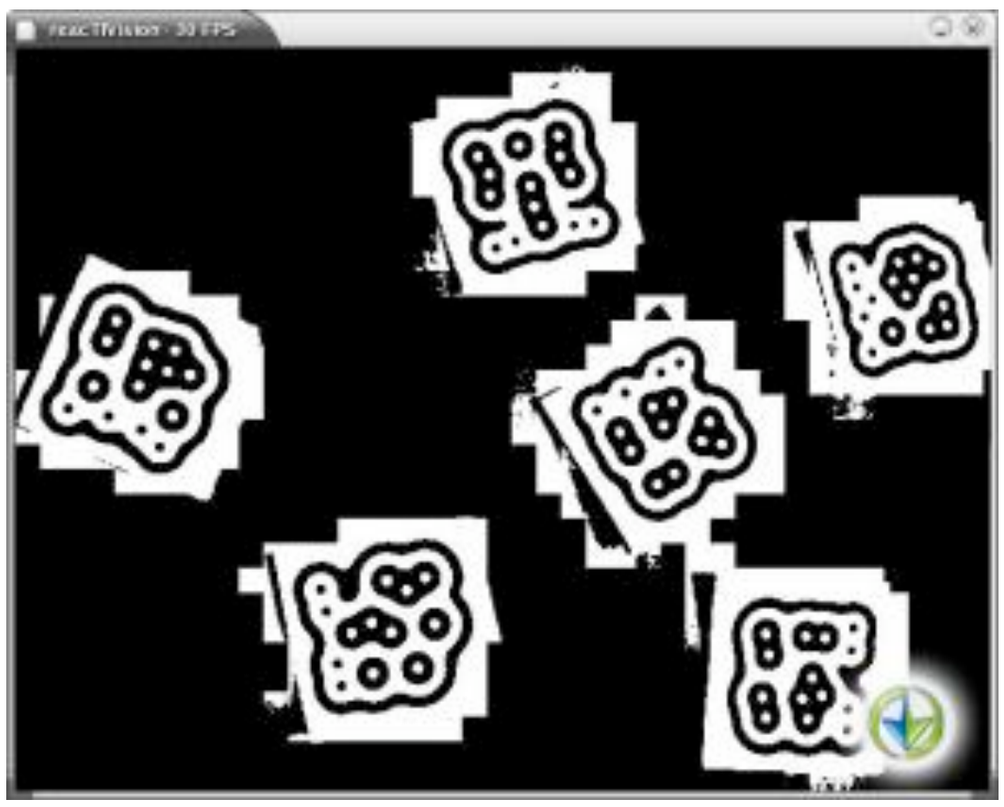
- The „classic“
- Touchlib is windows only
- CCV also Linux + OSX
- library for finger touch
- works w. diff. technologies

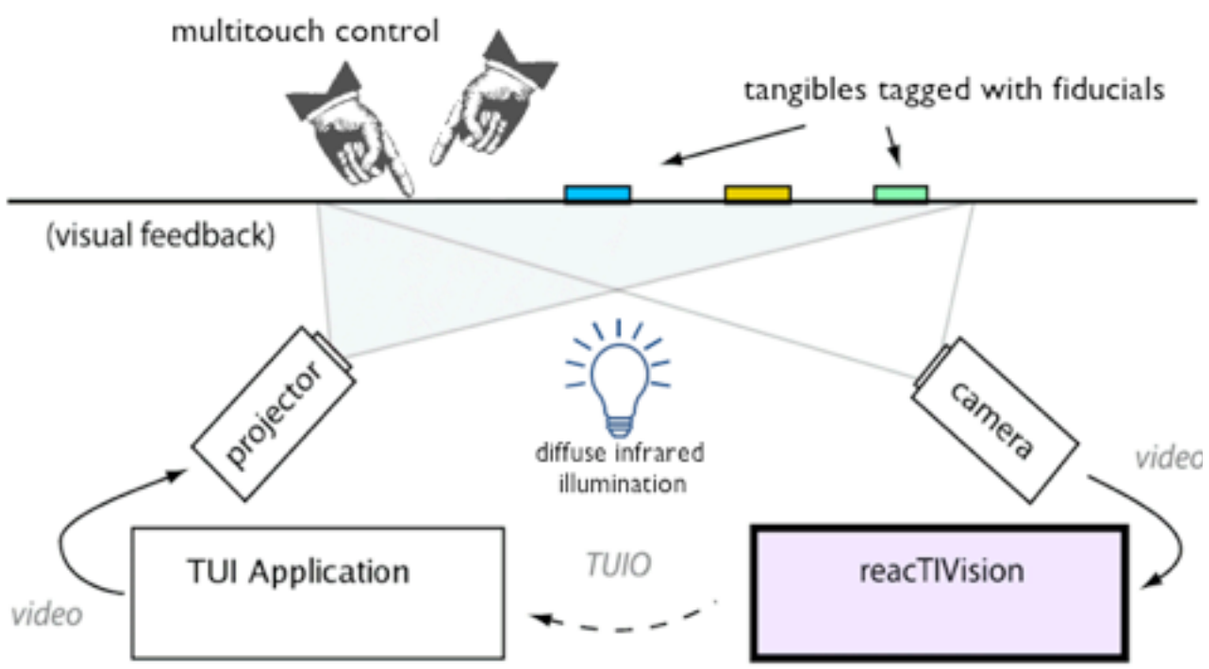


- also comes with a calibration app and several demos
- flame demos often seen in multi touch demo videos

Reactivision

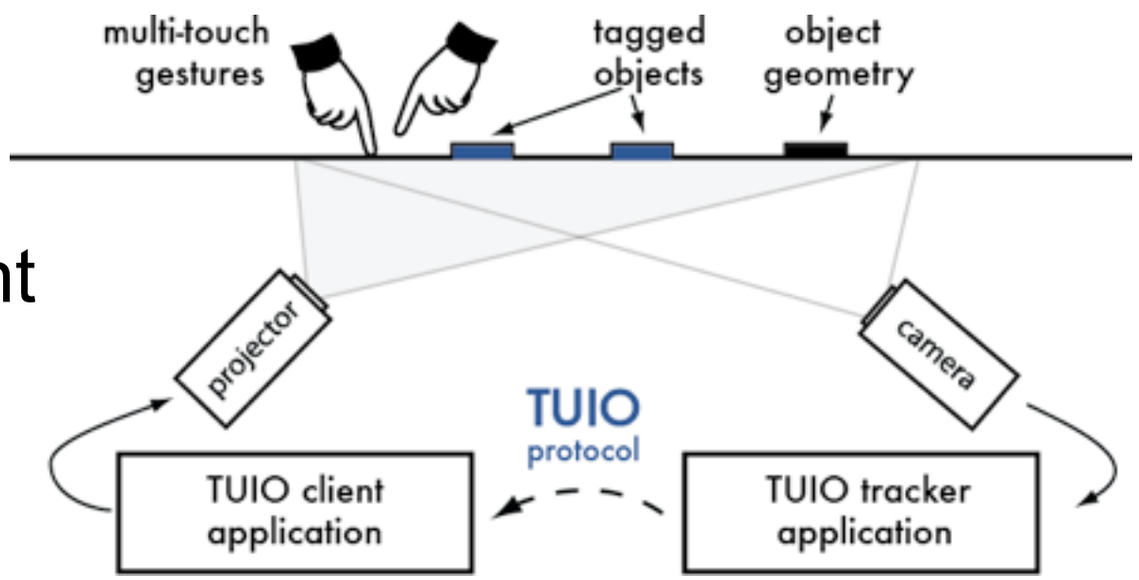
- includes marker (aka fiducial) tracking
- uses the TUIO protocol
- originally built for the ReacTable musical instrument
- used in research for various purposes





TUIO protocol

- Standardized protocol to send touch events
  - can describe fingers, shapes and visual markers
  - Sent over a network socket (often UDP packets on port 3333)
  - input can also be simulated
  - platform independent
- Various implementations (e.g., reactivision + CCV)
- Various demo clients available
- current version 1.1
- version 2.0 in preparation
  - extensions to the message content
  - new capabilities



Squidy

- visual interface for application programming
- pipe and filter paradigm, comes with predefined filters