Hardware-Setups for Interactive Stereoscopic Surfaces

ISIS3D Tutorial @ ITS 2013, St Andrews

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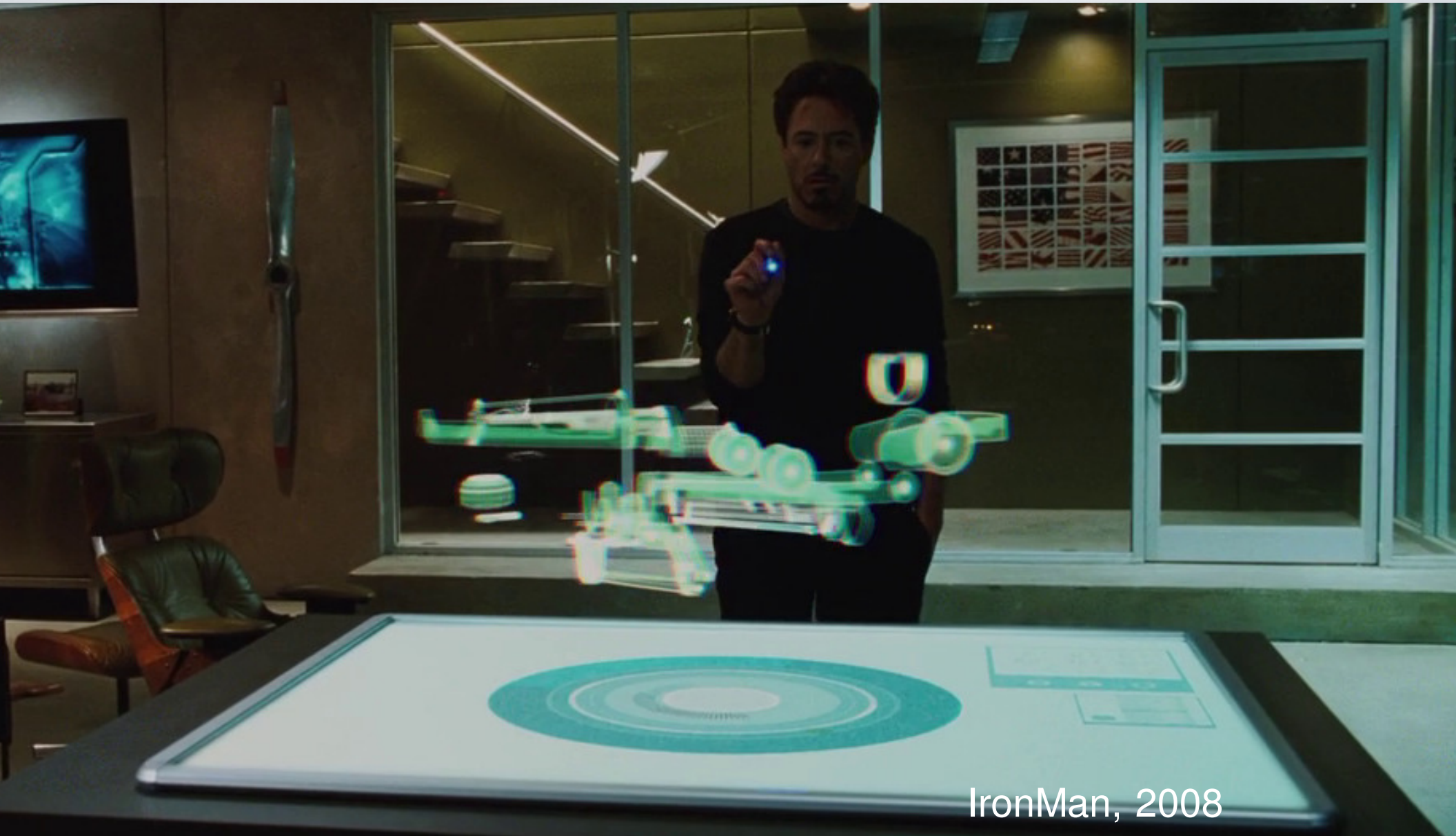
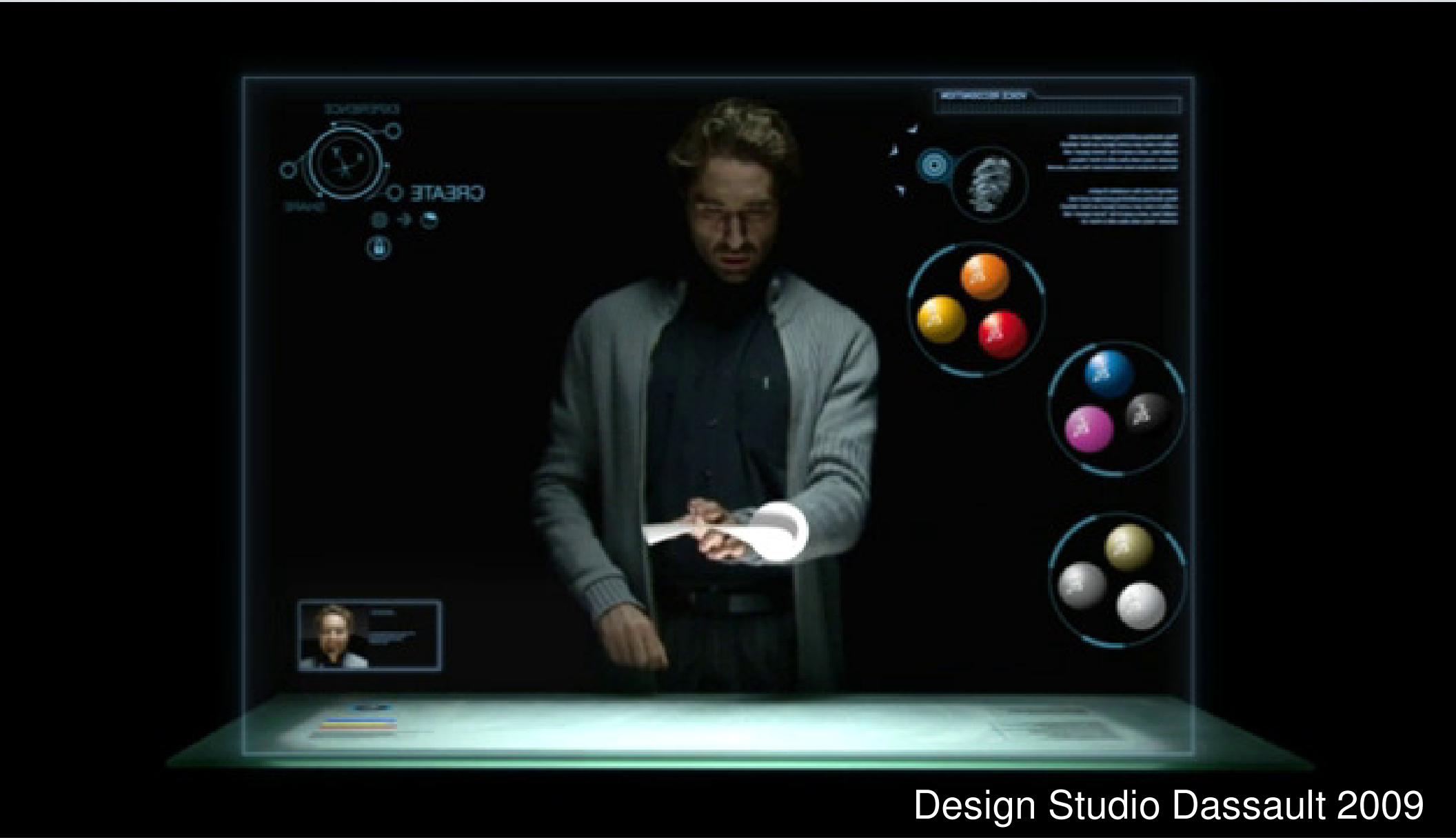
3D User Interface Visions

Nathan Shedroff and Christopher Noessel. Make it So: Interface Design Lessons from Sci-Fi. Rosenfeld Media, September 2012.

Scifi Vision



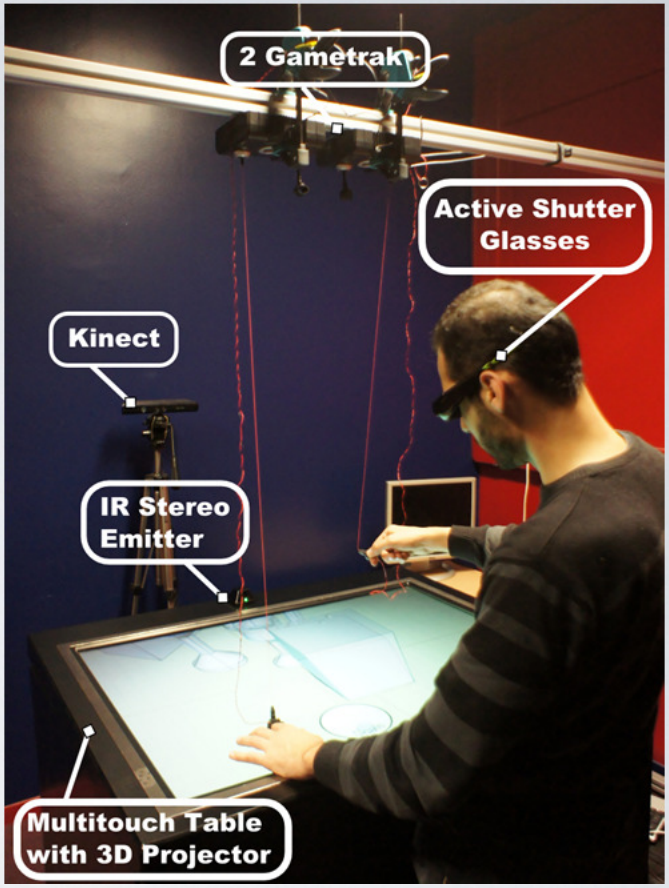
CAD Sellers Vision



CAD Sellers Vision

Outline

- Overview
- 2D Input MT
- Output 3D
- 3D Inputs
- Putting It All Together



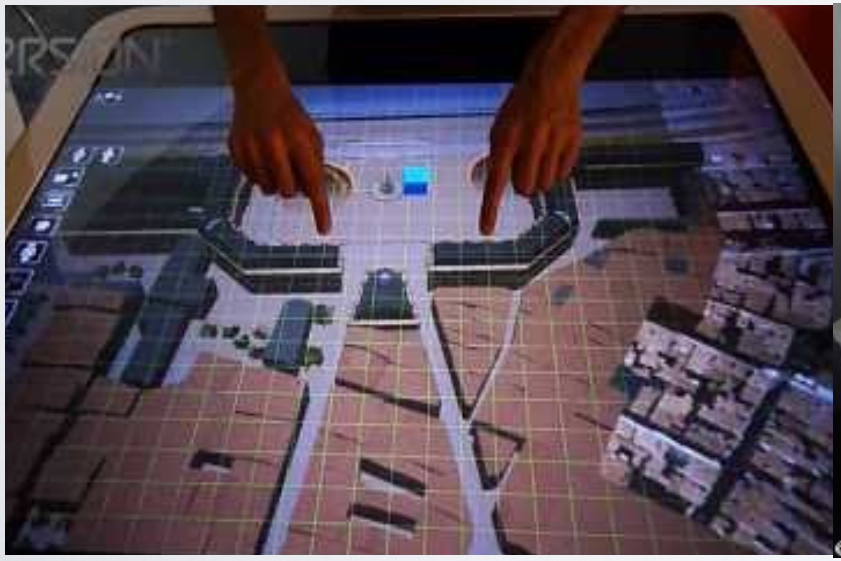
Hardware-Setups for Interactive Stereoscopic Surfaces

STEREOSCOPIC SURFACES OVERVIEW

Commercial Solutions

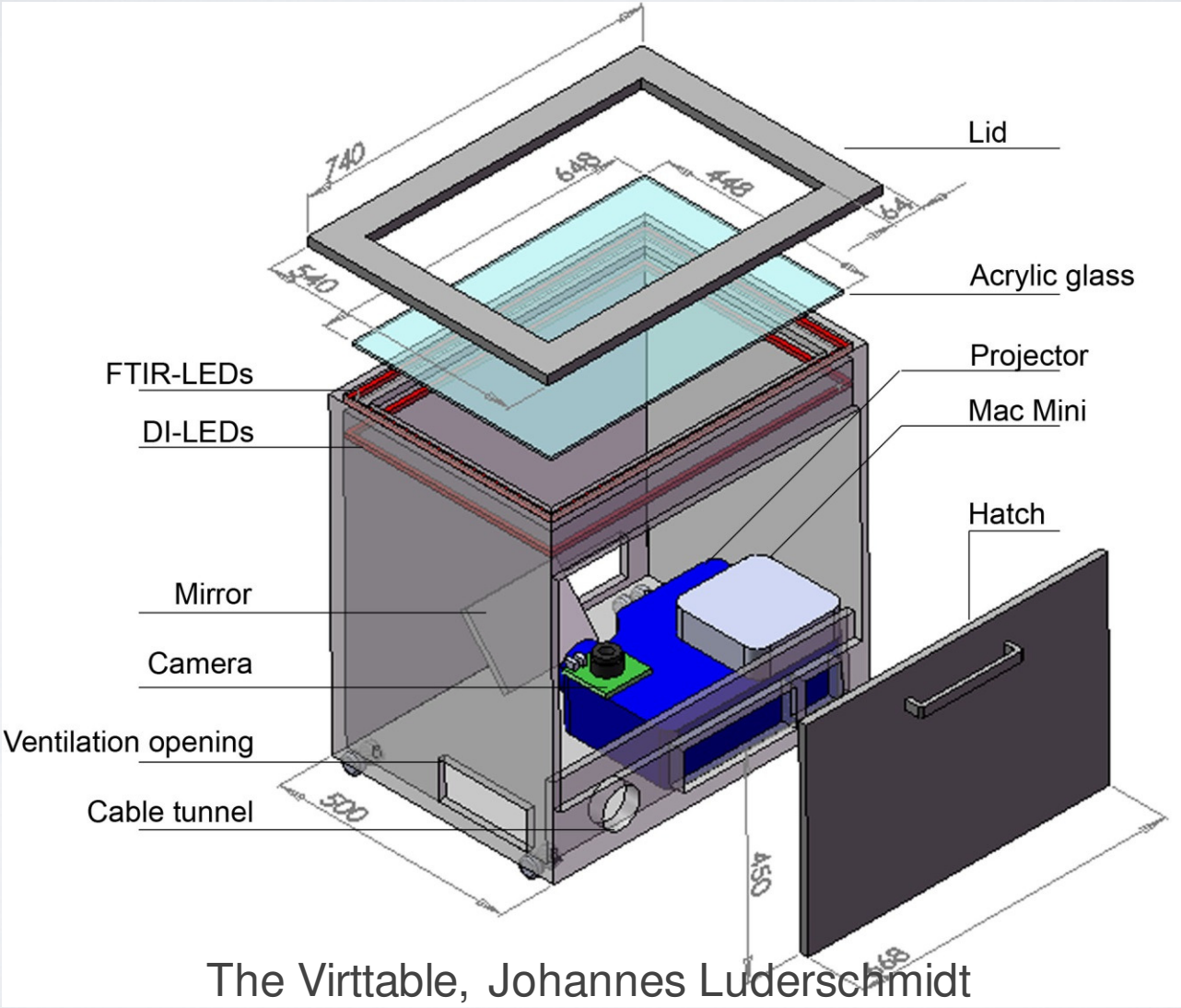
Perceptive Pixel 55”

ZSpaceSystem 24”



Immersion iliGHT 3D-Touch

DIY Multi-touch Table

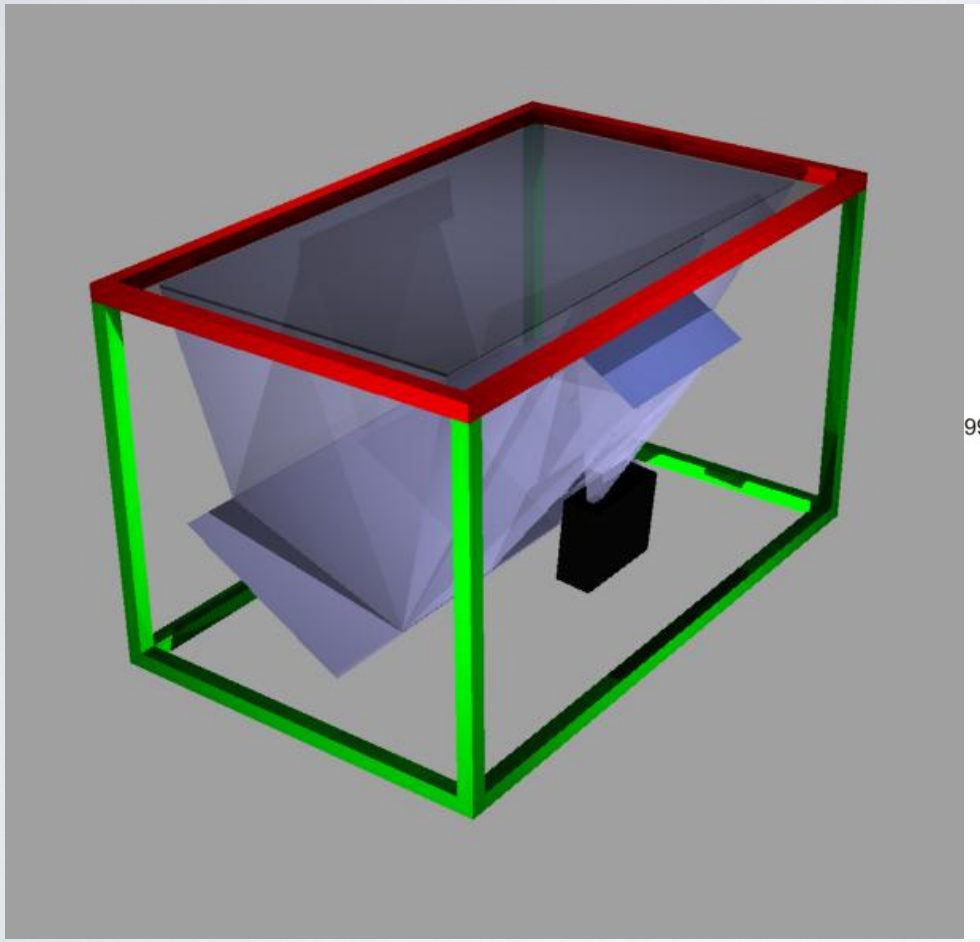


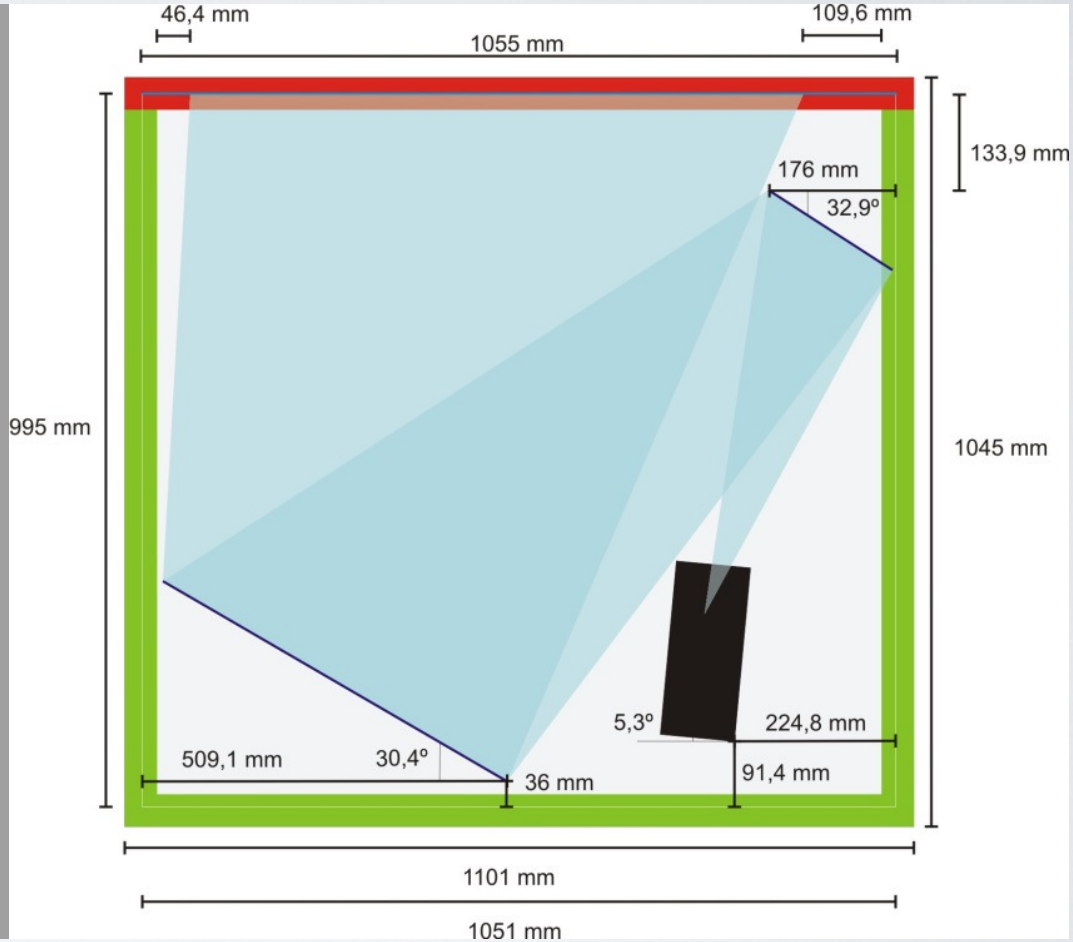
The Virttable, Johannes Luderschmidt

HW Design Choice

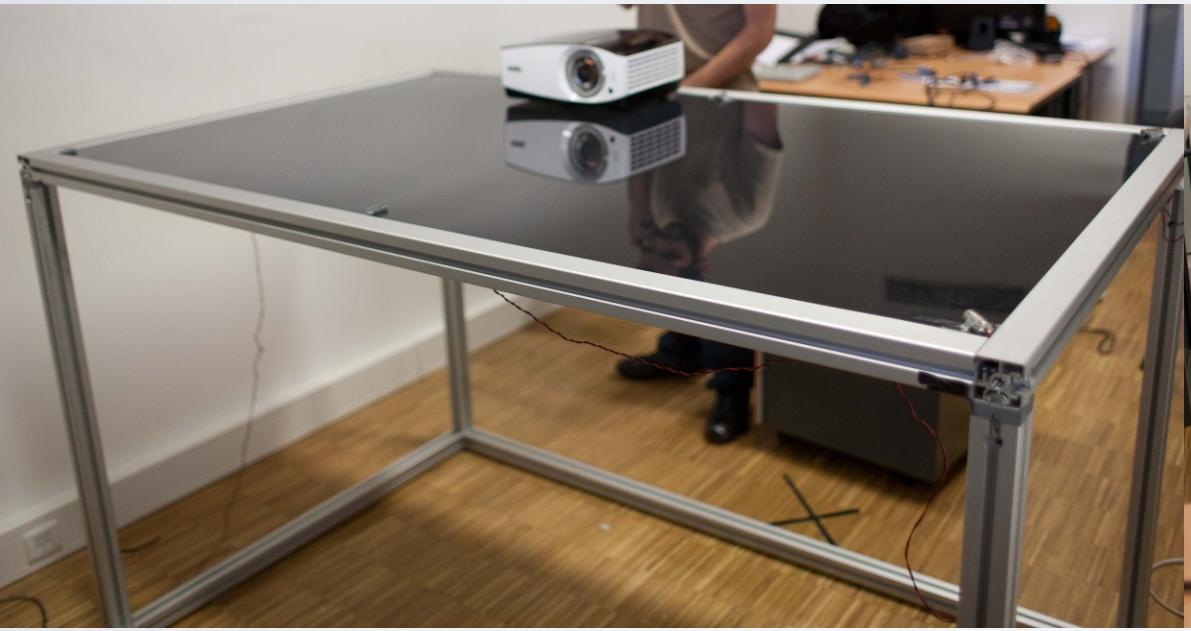
- 3D Vision System : TV or Projector
- Multi-touch Sensor
- 3D Tracking
- 3D Inputs
- Frame & Packaging

Vision & Packaging





Frame Example

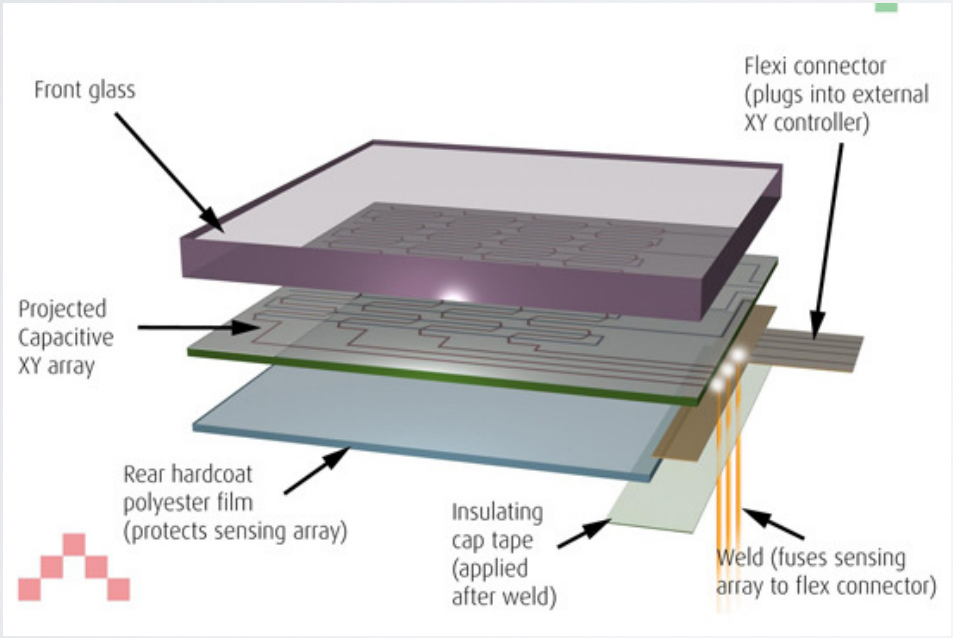


Hardware-Setups for Interactive Stereoscopic Surfaces

INPUT: MULTI-TOUCH TECHNOLOGIES

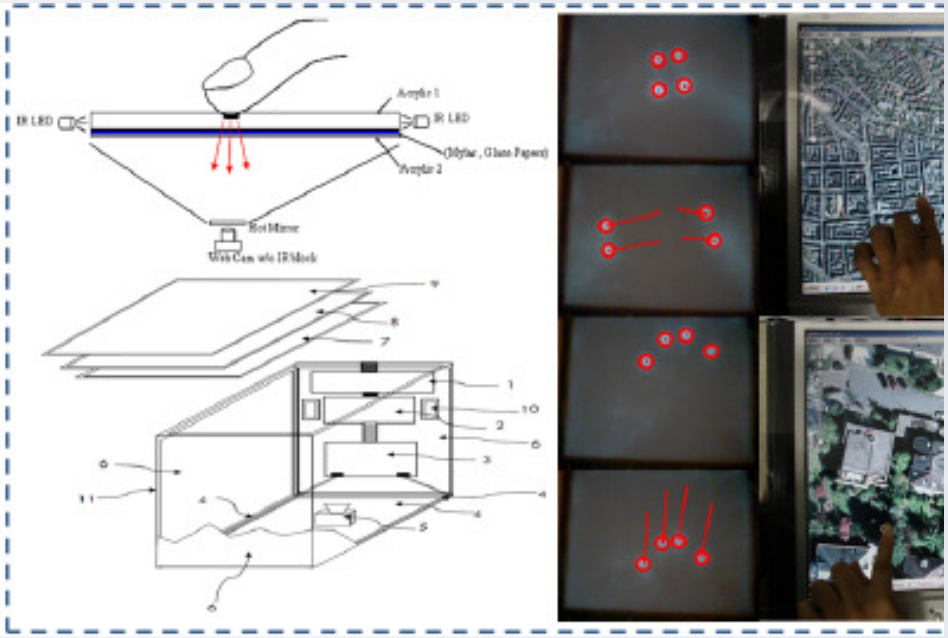
Multi-Touch Strategies

Sensor Based Solutions



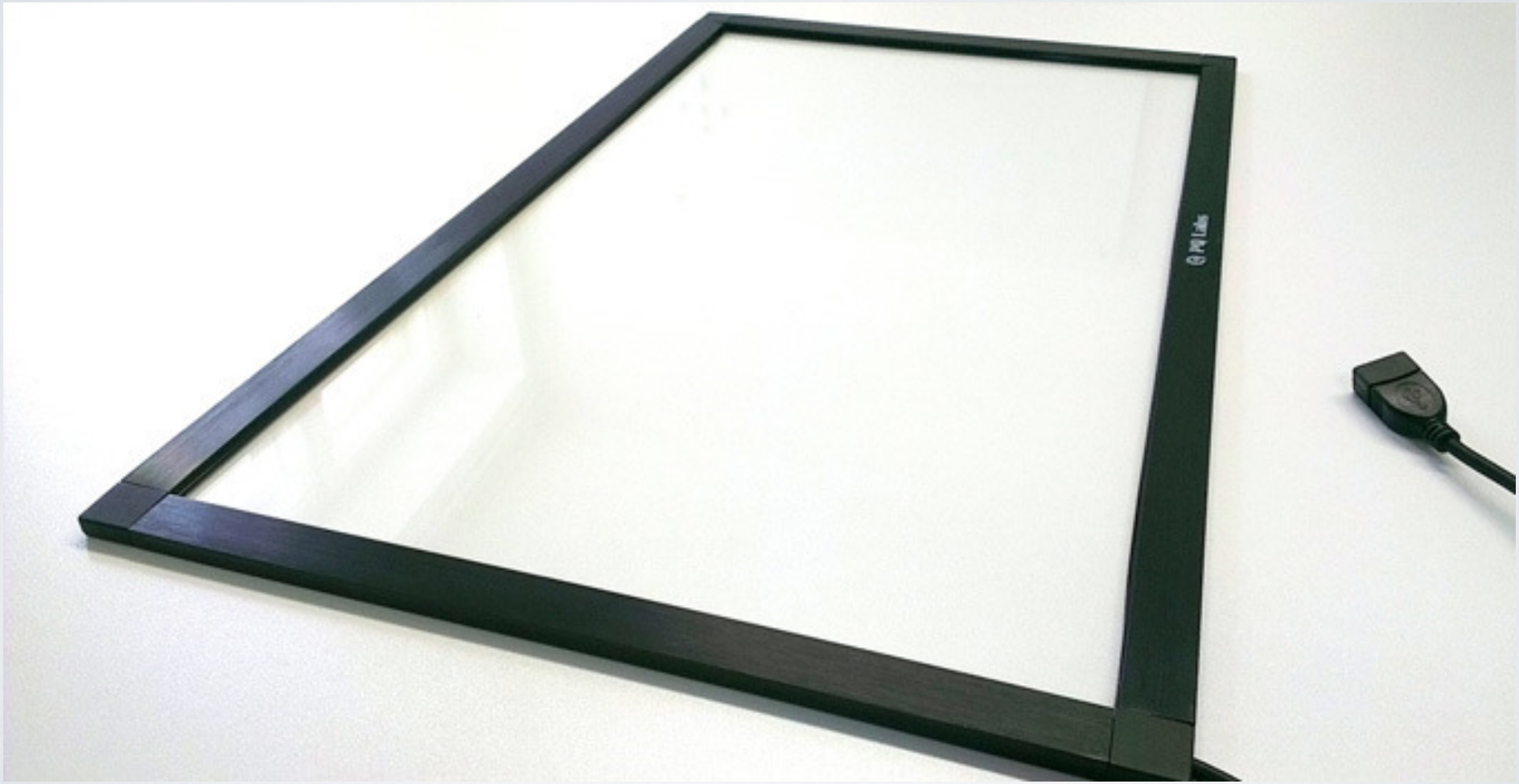
Zytronic PCT

Vision Based Solutions



Chen et al., Vision-Based Finger Detection, Tracking, and Event Identification Techniques for Multi-Touch Sensing and Display Systems, Sensors, 2011

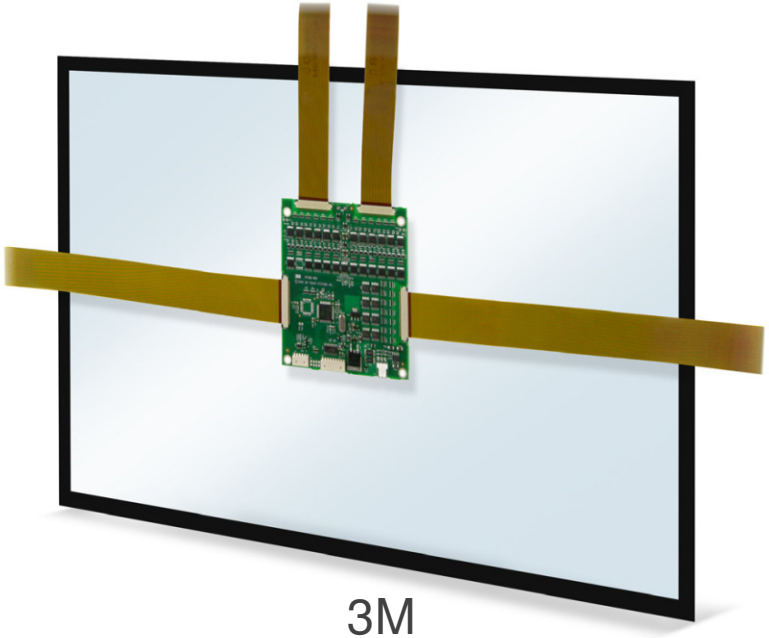
IR Based Touch Frame Overlays



Examples: PQ Labs, ZaagTech

Projected Capacitive Touch

Displax



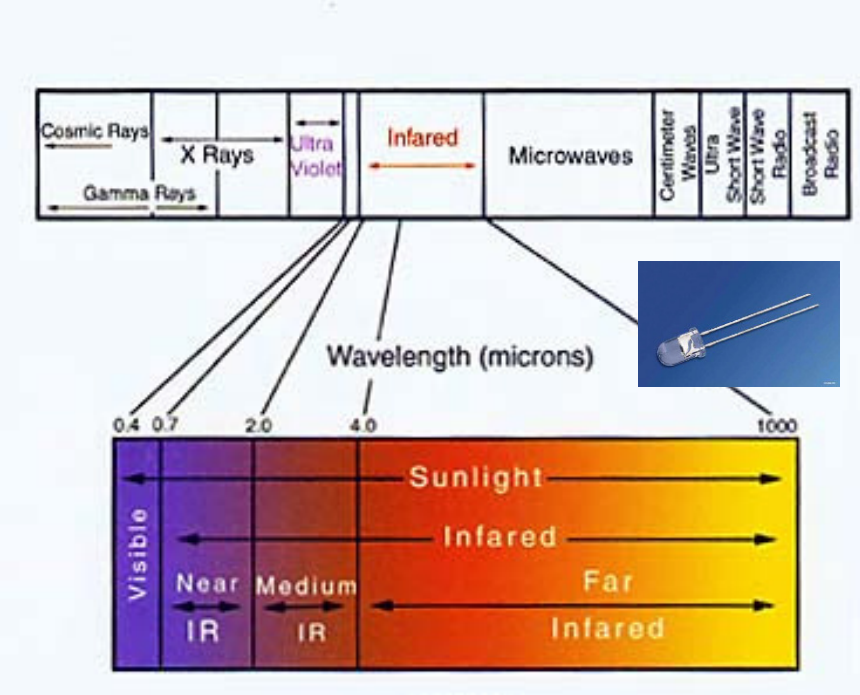
3M

Film

Complete Frame

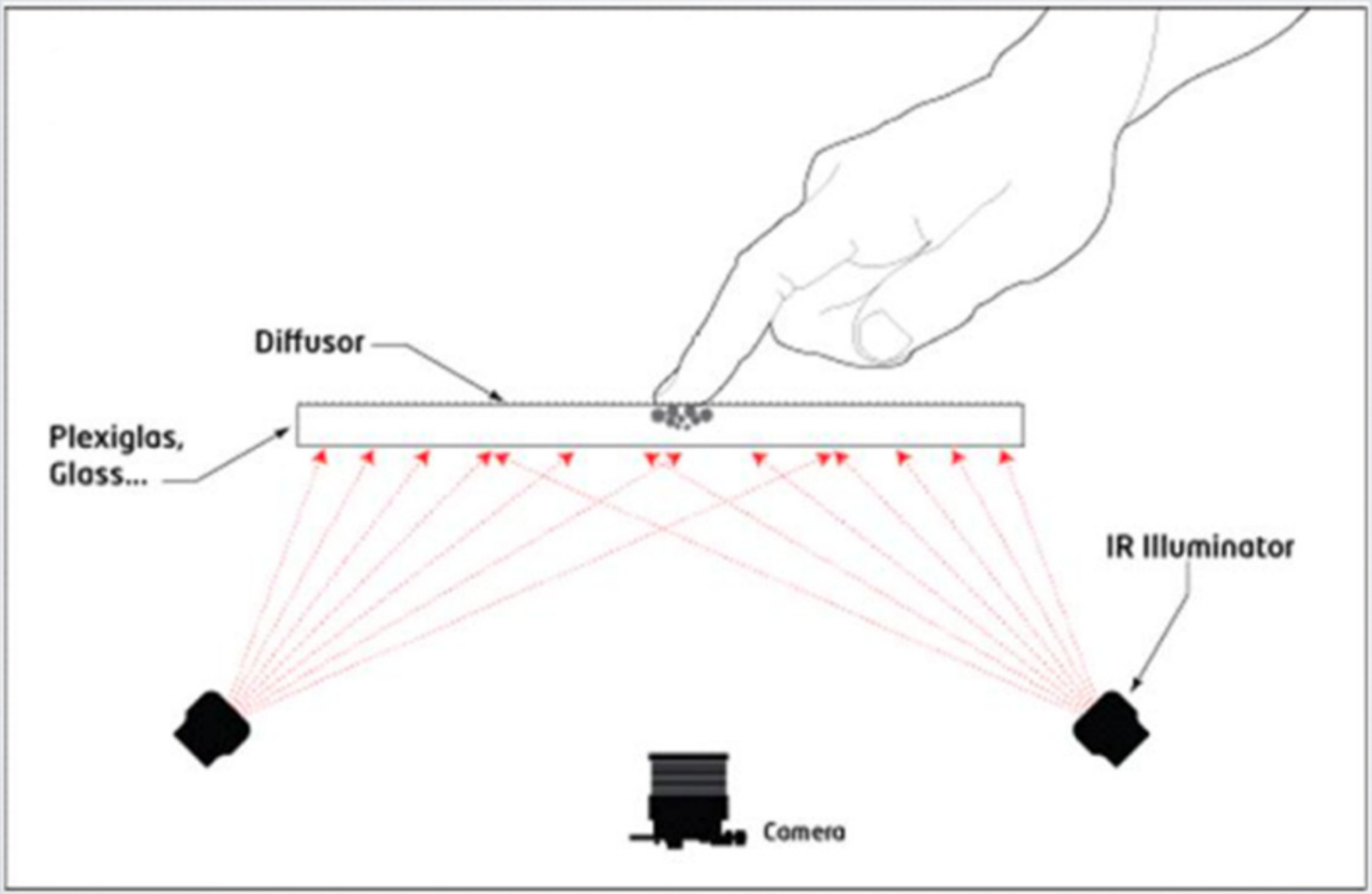
Vision Based Multi-touch

- Near Infrared Light
  MT : 750 – 940 nm
  Common : 780 – 880 nm



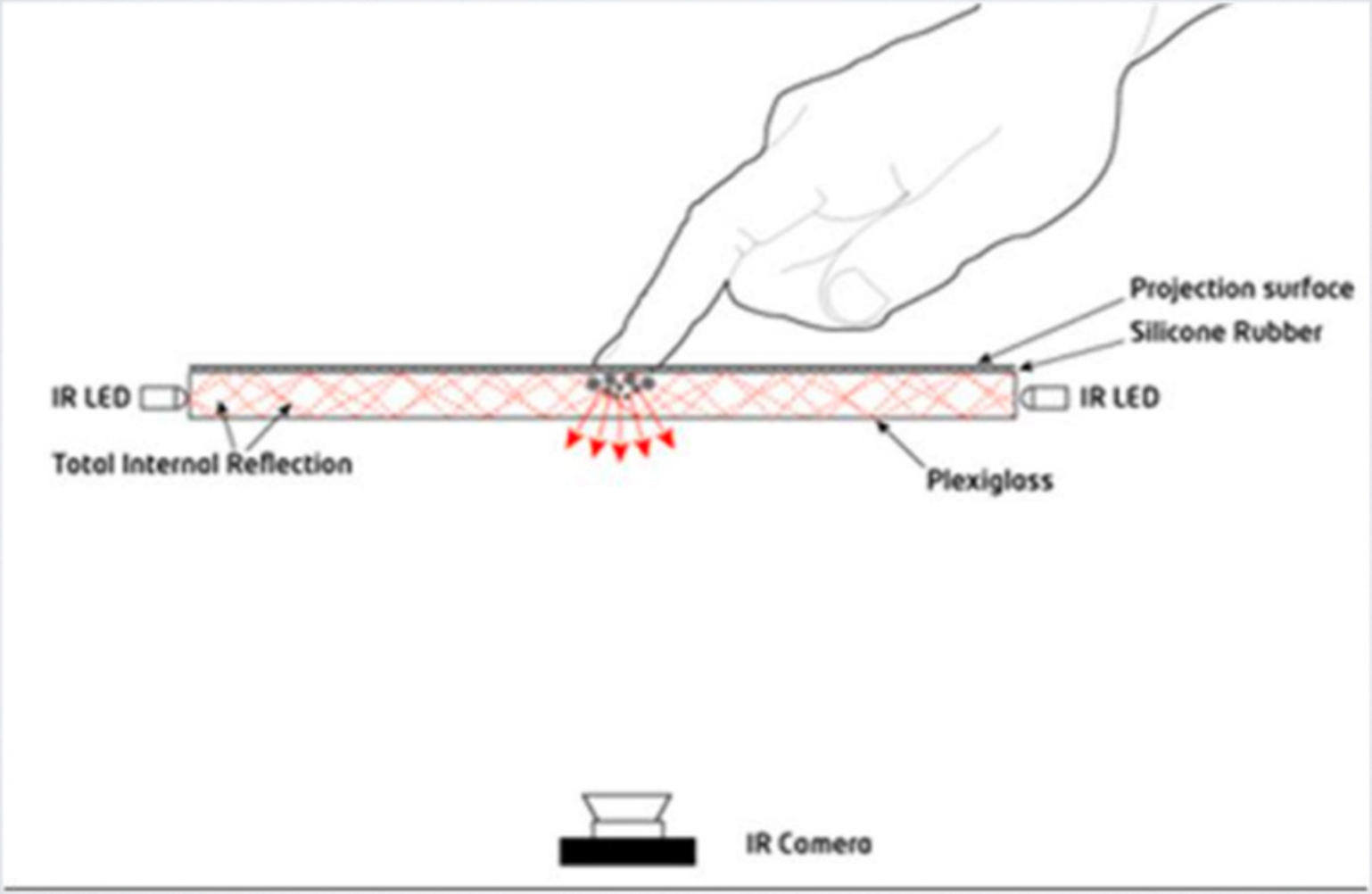
Multi-touch Input Technology

- (Rear) Diffused Illumination DI



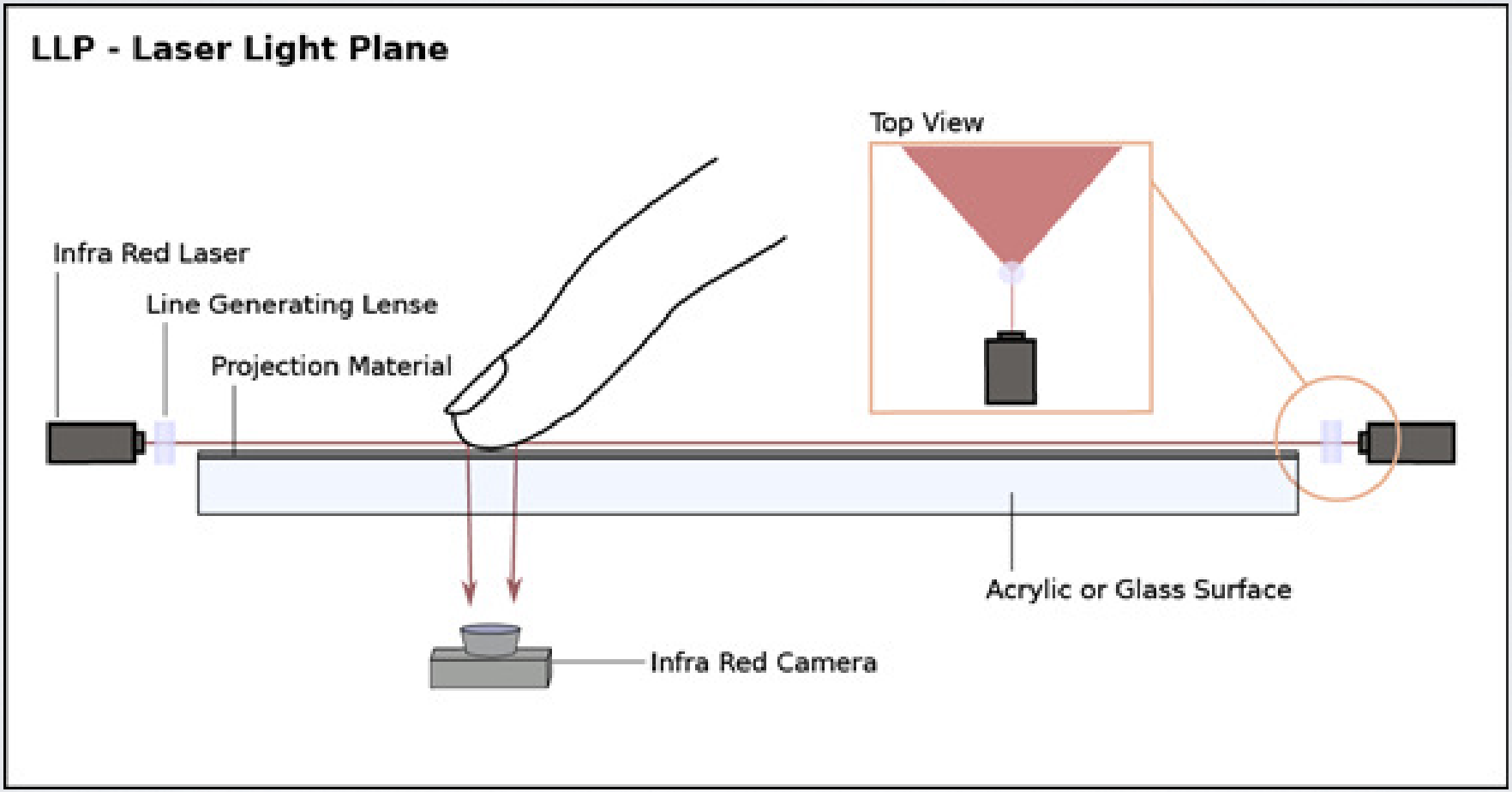
Multi-touch Input Technology

- **Frustrated Total Internal Reflection FTIR**

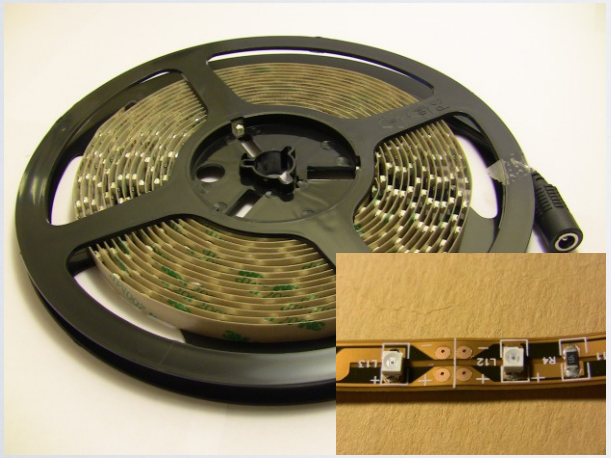


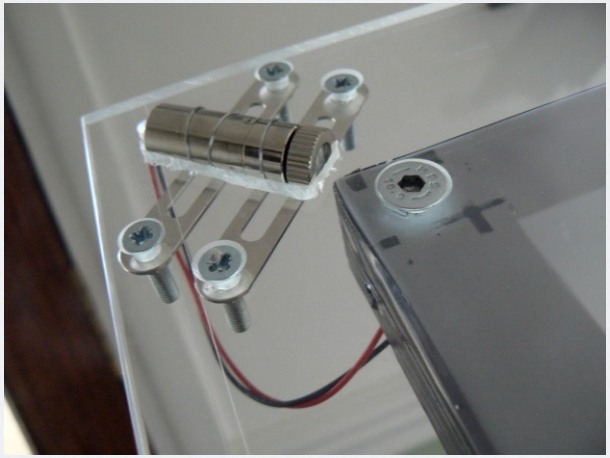
Multi-touch Input Technology

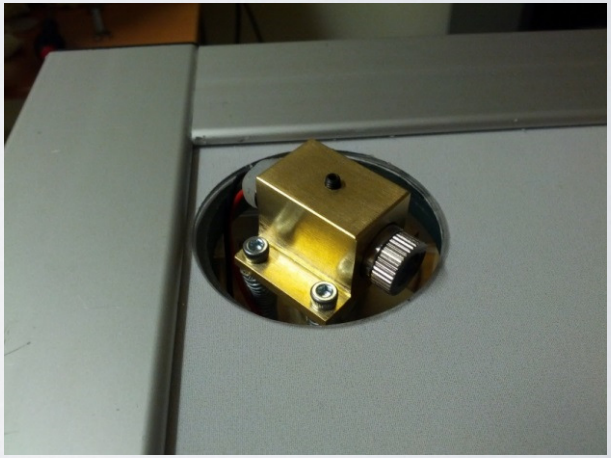
- Laser Light Plane LLP



Infrared Light Solutions

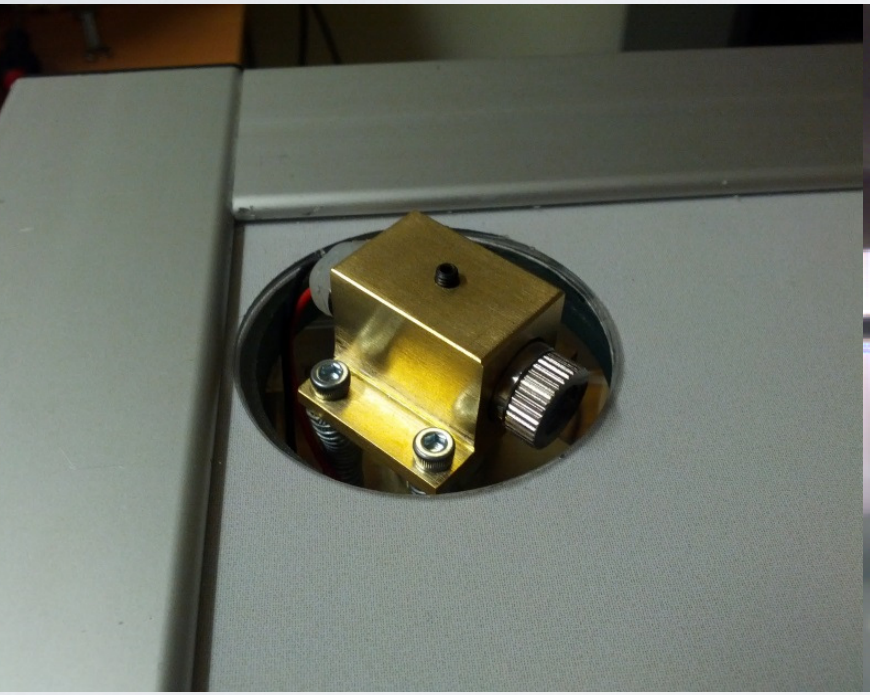


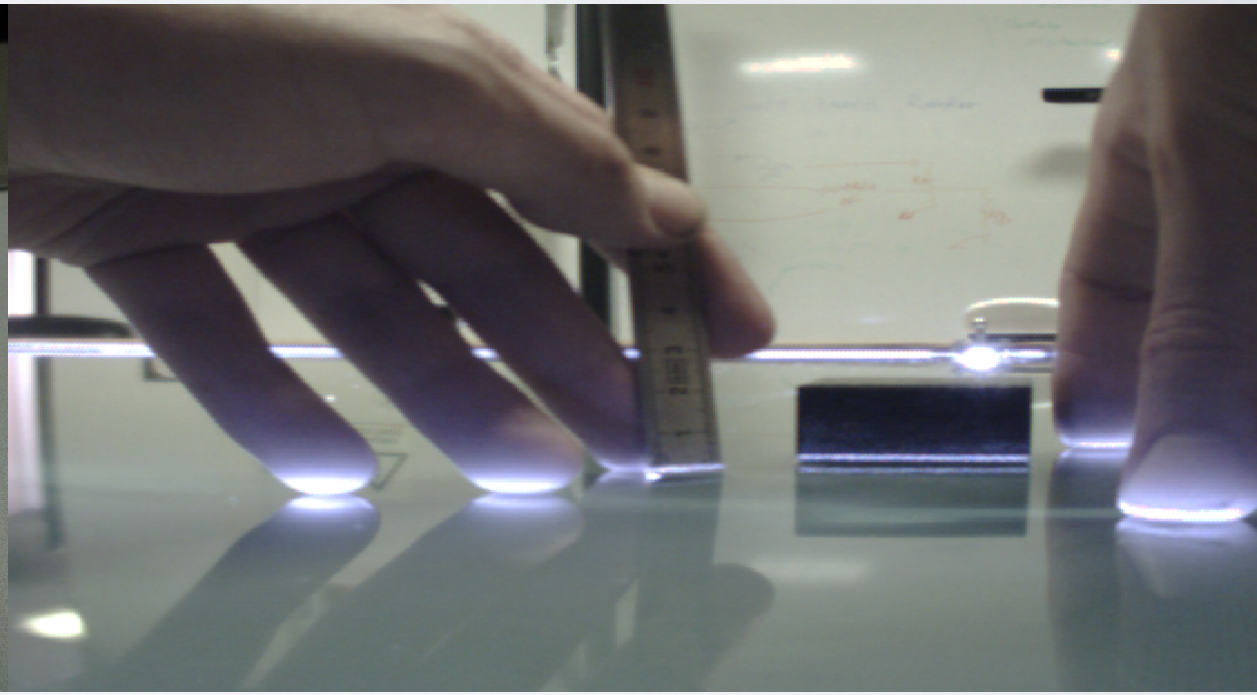




http://peauproductions.com

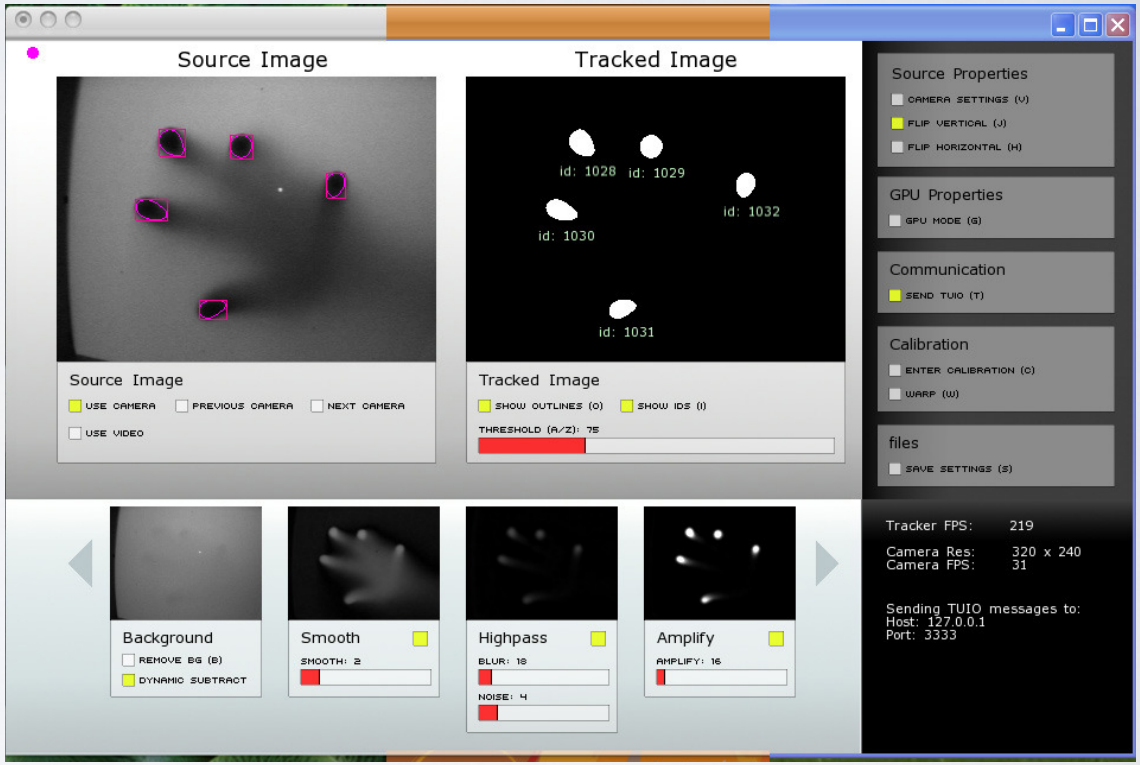
LLP Surface Example





MT Software

- OS Recognized Touches (WM_TOUCH)
- Proprietary API
- USB/HID
- Vision Based Software



NUIGroup.com

TUIO Protocol

- Open Source Spec.
  - http://tuio.org/
- OSC
- UDP / TCP (3333)
- Multi Device
- Multi Platform
- 2D , 3D, Tangibles

2D Interactive Surface
/tuio/2Dobj set s i x y a X Y A m r
/tuio/2Dcur set s x y X Y m
/tuio/2Dblb set s x y a w h f X Y A m r
2.5D Interactive Surface
/tuio/25Dobj set s i x y z a X Y Z A m r
/tuio/25Dcur set s x y z X Y Z m
/tuio/25Dblb set s x y z a w h f X Y Z A m r
3D Interactive Surface/
tuio/3Dobj set s i x y z a b c X Y Z A B C m r
/tuio/3Dcur set s x y z X Y Z m
/tuio/3Dblb set s x y z a b c w h d v X Y Z A B C m r
custom profile
/tuio/_[formatString]
/tuio/_sixyP set s i x y 0.57

Hardware-Setups for Interactive Stereoscopic Surfaces

OUTPUT: 3D TECHNOLOGIES

3D Projectors & TVs

- High Res => Low Brightness
- 120 Hz Sequential
- HDMI 1.4a
- Short-Throw , Mirrors

Optoma GT750

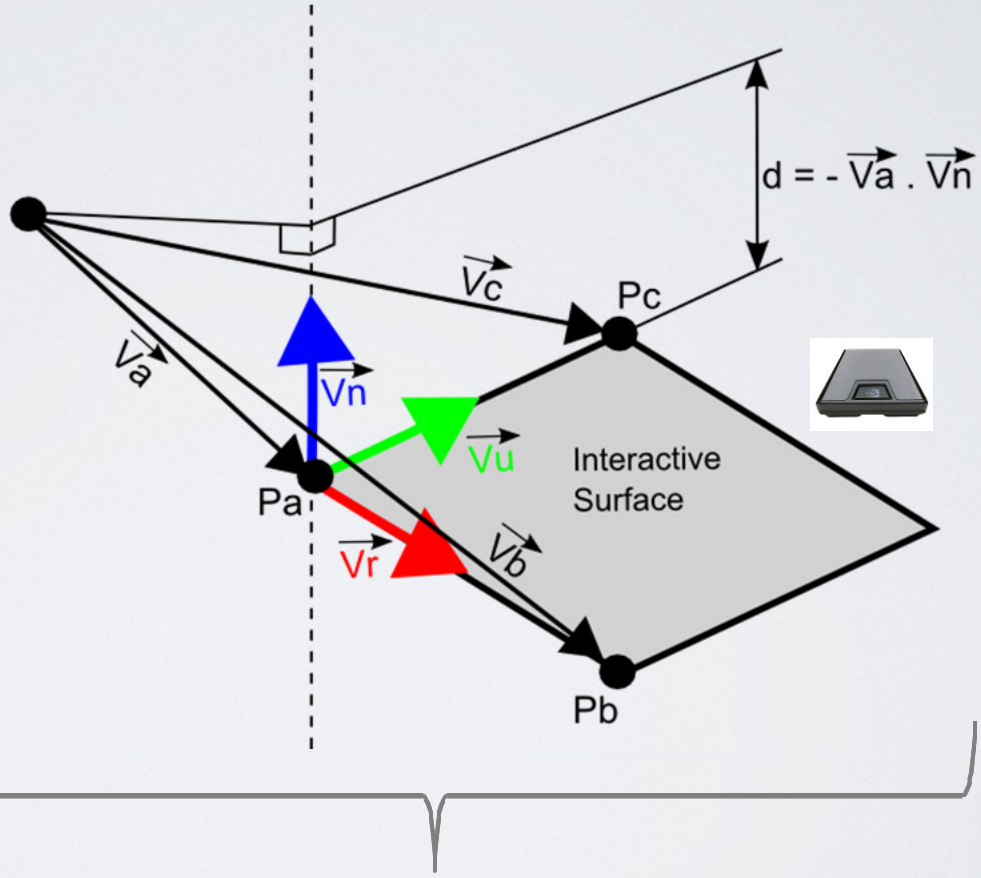
Output 3D

- Stereo Capabilities
- Graphic Cards
- Glasses + Emitters

Nvidia Quadro and Vision

3D Visualization

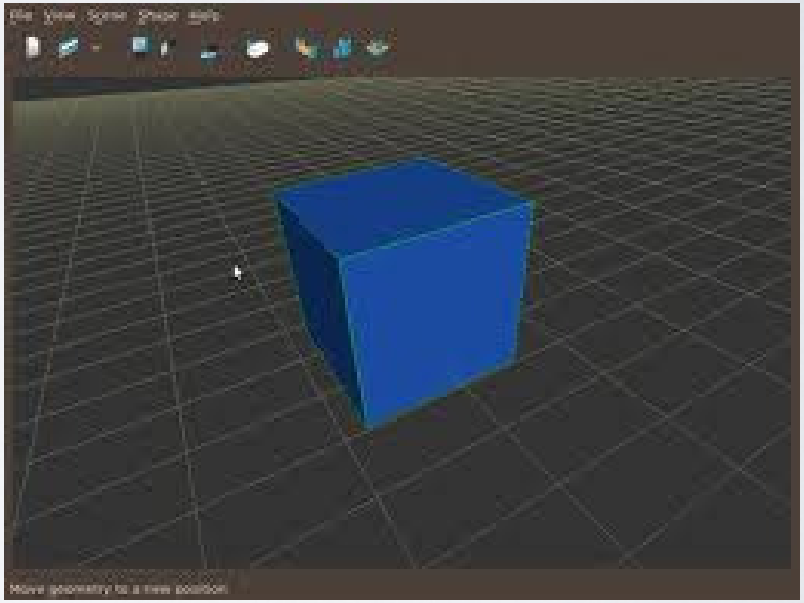
120 Hz
Shutter Glasses



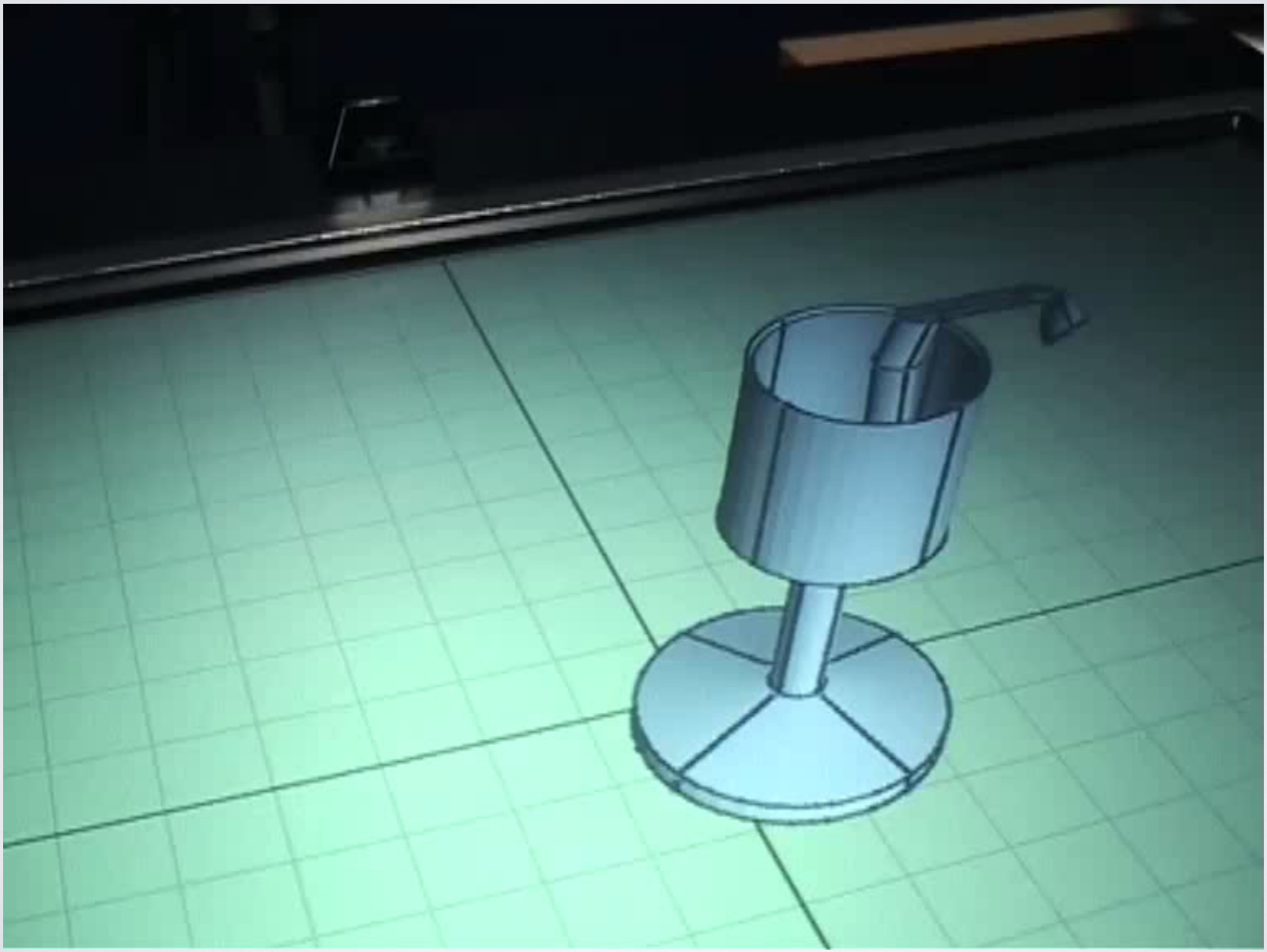
x2 Per each eye (Interpupillary Distance 6 cm)

Rendering Solutions

- Render Engine or Frameworks
  - OpenGL, OpenSG
  - Cinder, Kiwy
  - Unity + MiddleVR,
  - Blender, Unreal , G3D



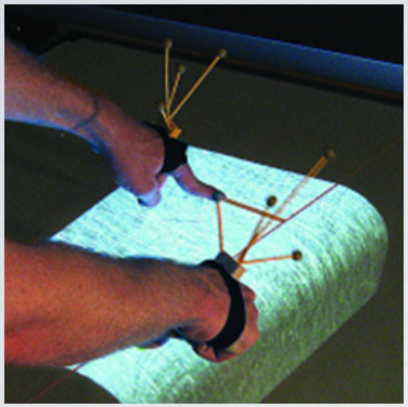
3D Visualization

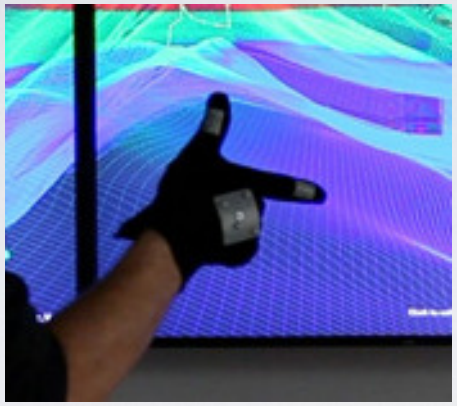


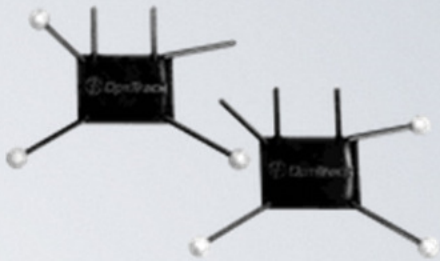
Hardware-Setups for Interactive Stereoscopic Surfaces

INPUT: 3D TECHNOLOGIES

Optical Tracking





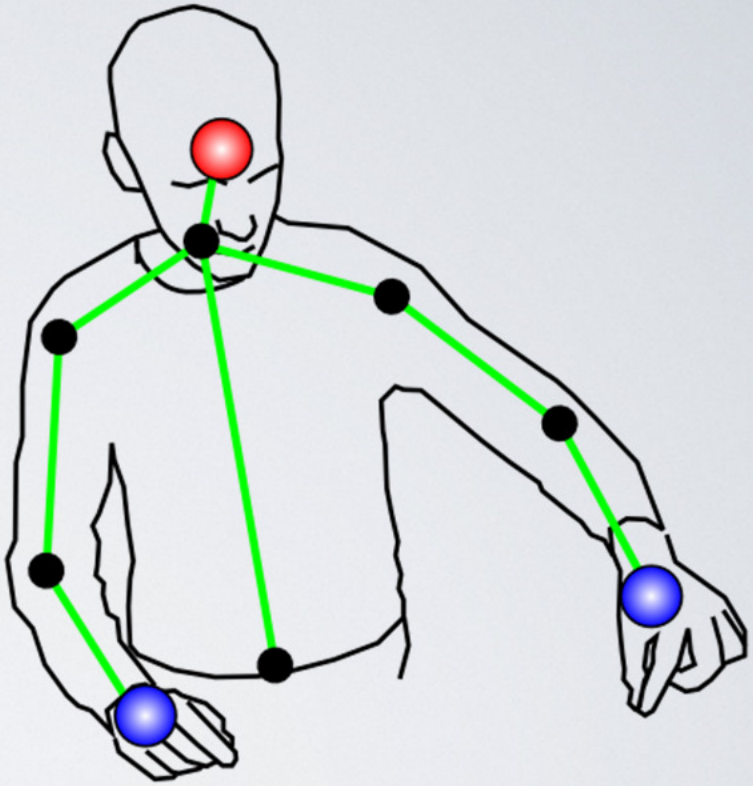


- Very Accurate
- 100 to 400 Hz
- VRPN
- Intrusive & Expensive

Body Tracking

KINECT

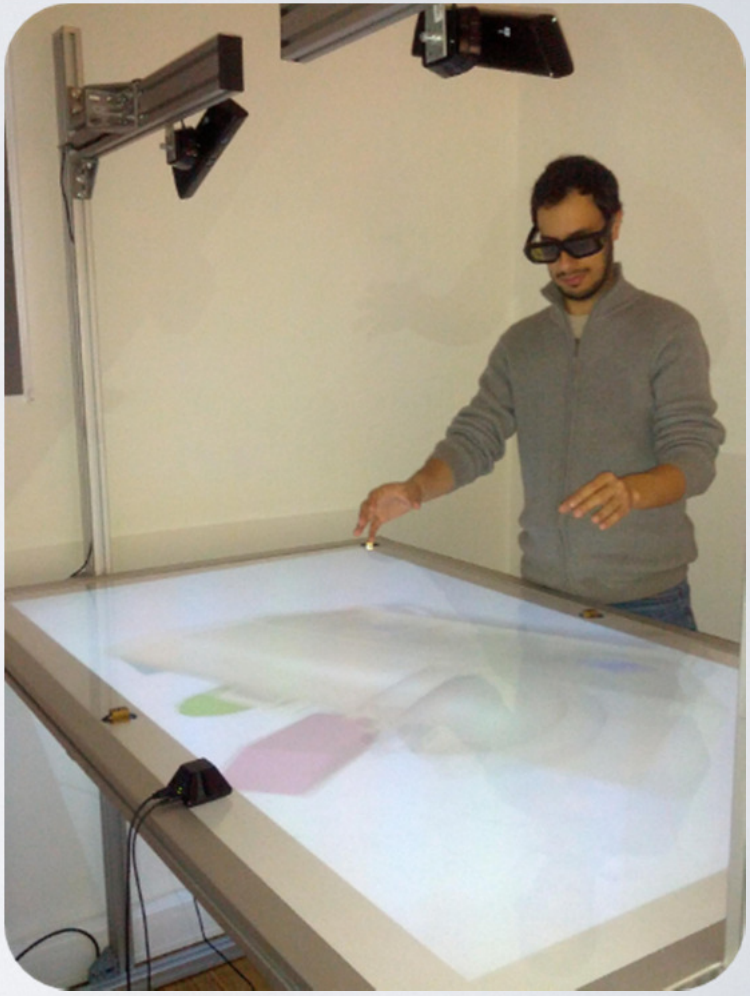
- Skeleton Tracking
- Pose Recognition
- 6 DOF Hand + Head
- Windows SDK
- OpenNI/NITE
- 30 Hz



Hand and Finger Tracking

3Gear systems

- Kinect Based (1 or 2)
- Mac OS, WIN 64 bits
- 6DOF Hand Tracking
- Finger tracking
- Pose Recognition
- 30 Hz



3D Finger Tracking

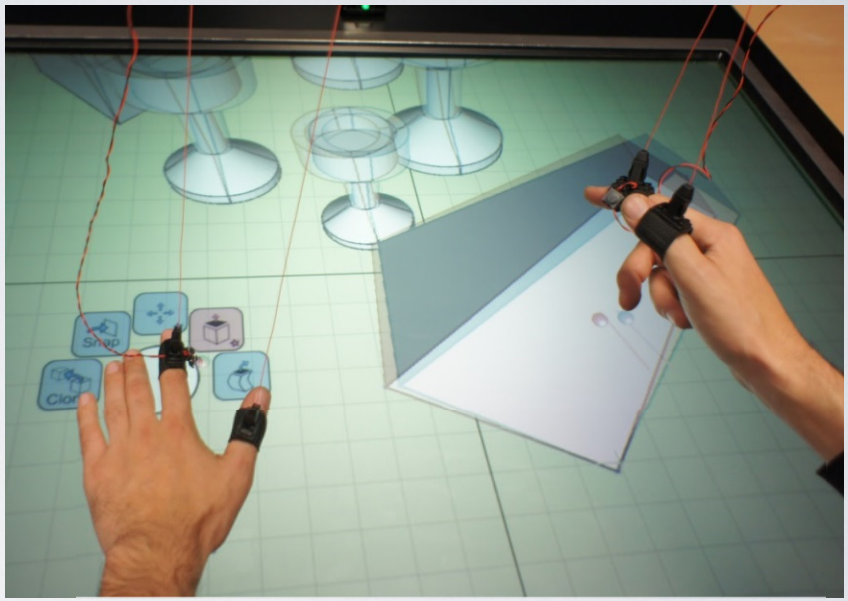
LEAP MOTION

- Mac OS, WIN
- 6DOF Hand Tracking
- Finger tracking
- Gesture Recognition
- Very Limited Volume
- 30 to 200 hz

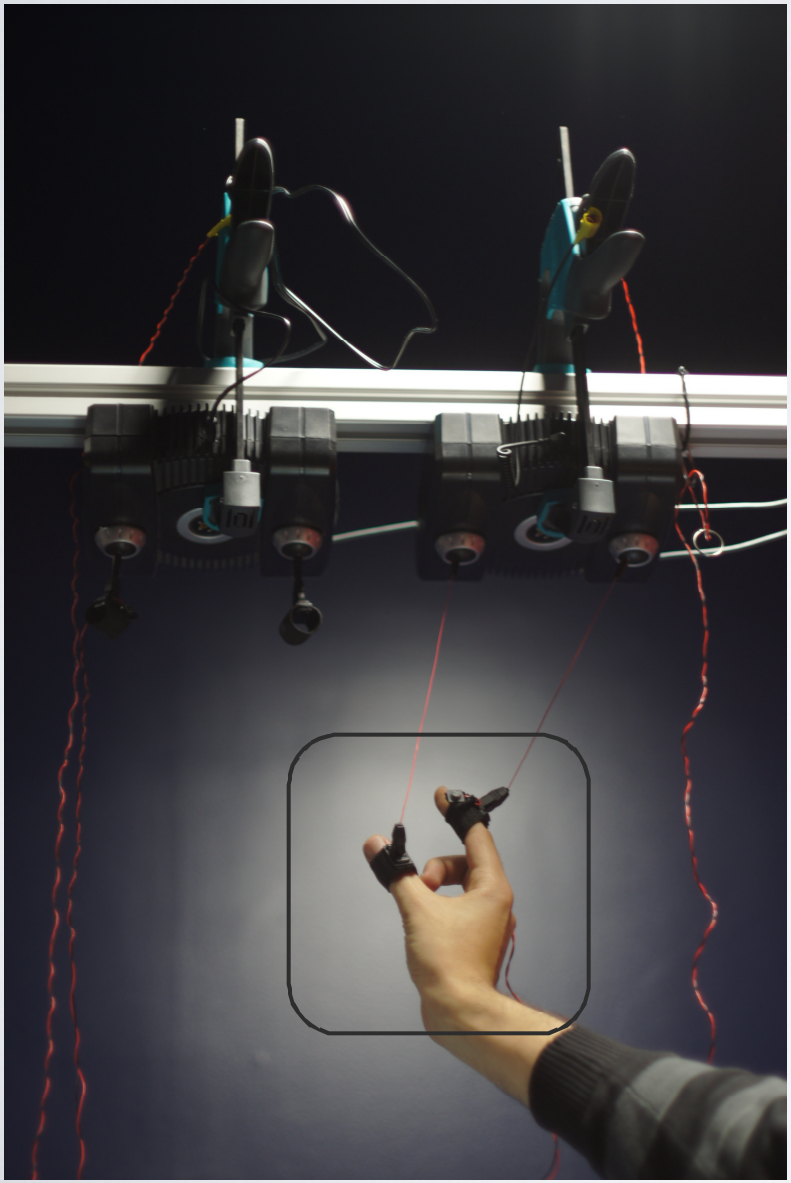
3D Finger Tracking

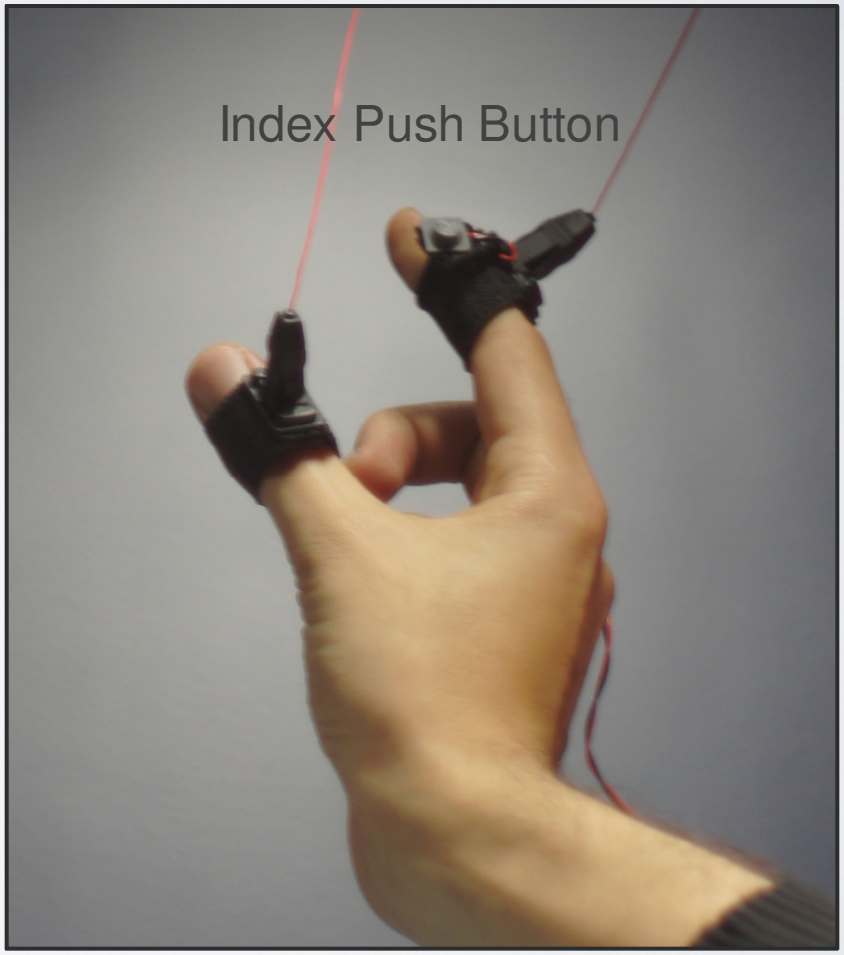
GAMETRAK

- String Length Based
- 2 x 3D Tracking
- Button input
- 100 Hz – 120 Hz
- Intrusive



3D Finger Tracking

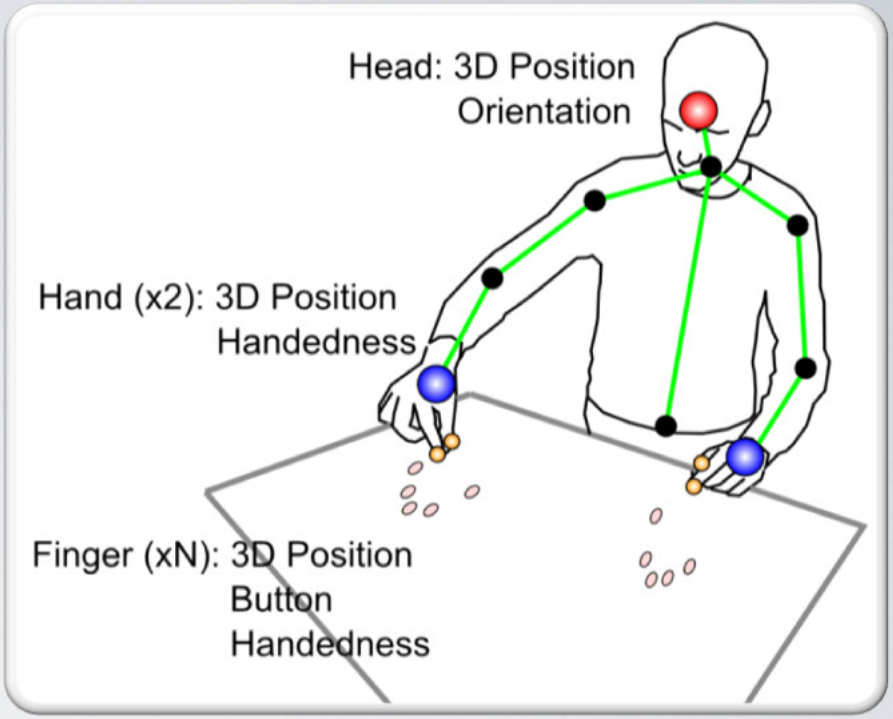




Other Devices

Common API and Protocols

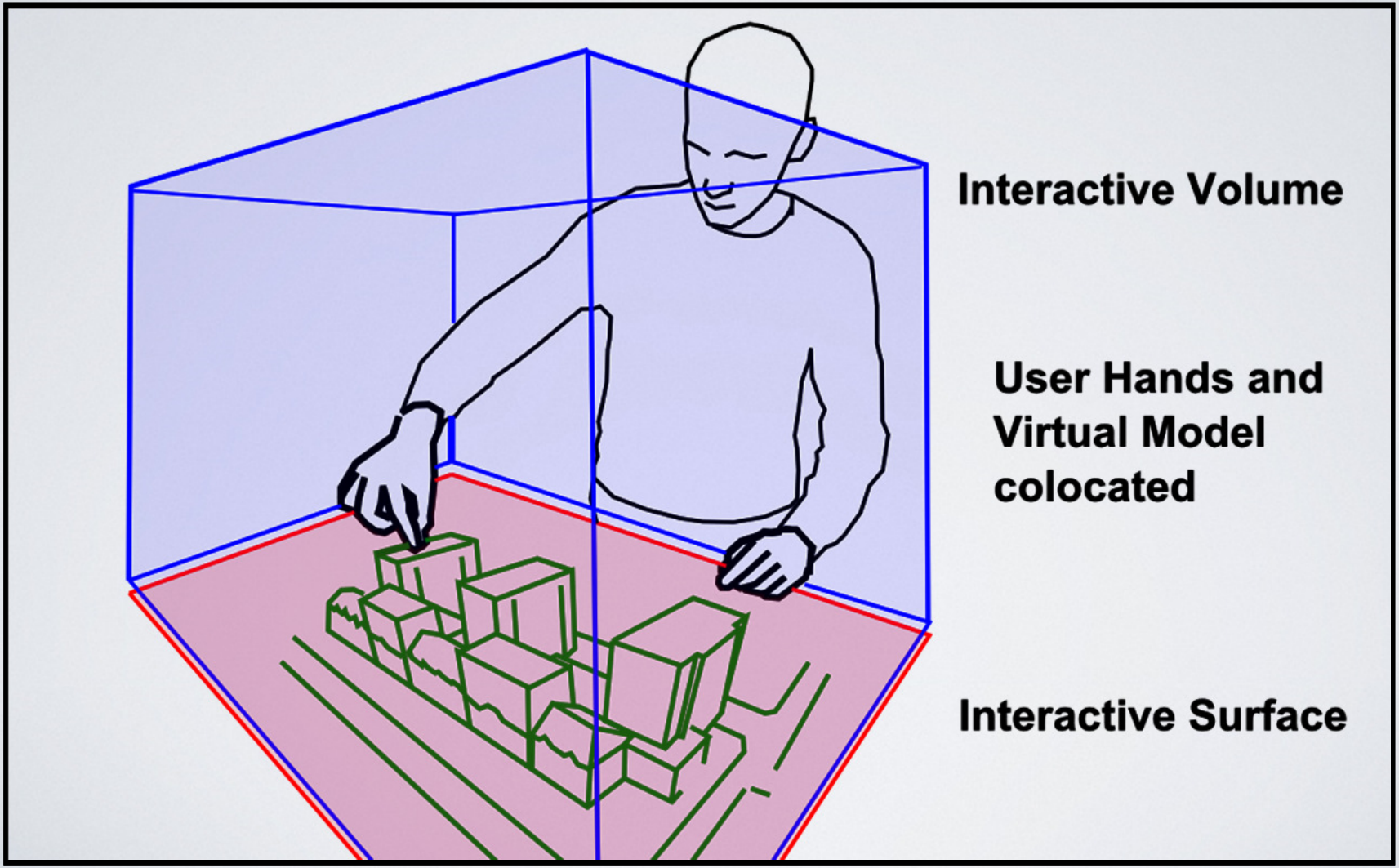
- OpenNI / NITE
- Kinect Windows SDK
- Three Gears
- FAAST
- VRPN
- TUIO



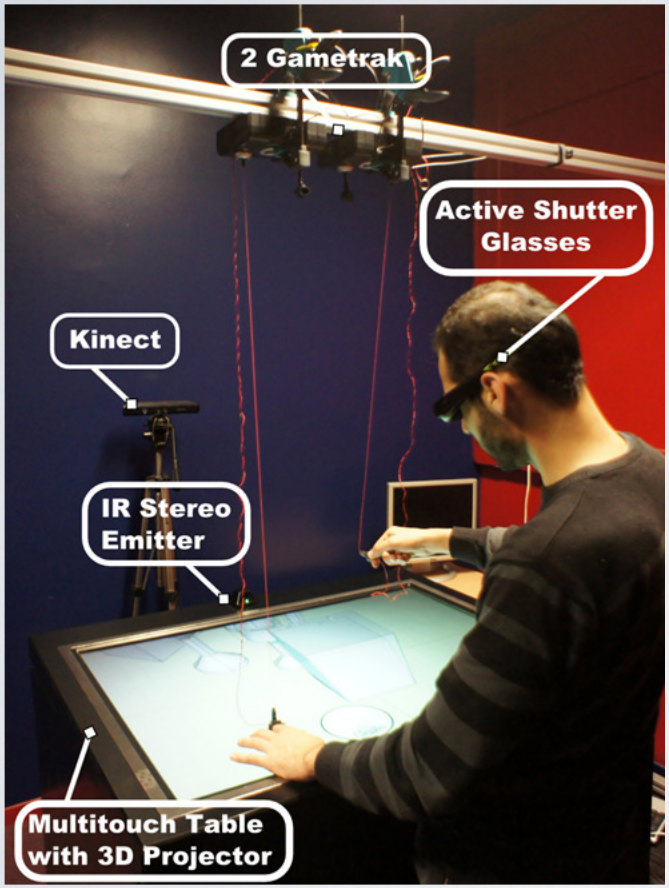
Hardware-Setups for Interactive Stereoscopic Surfaces

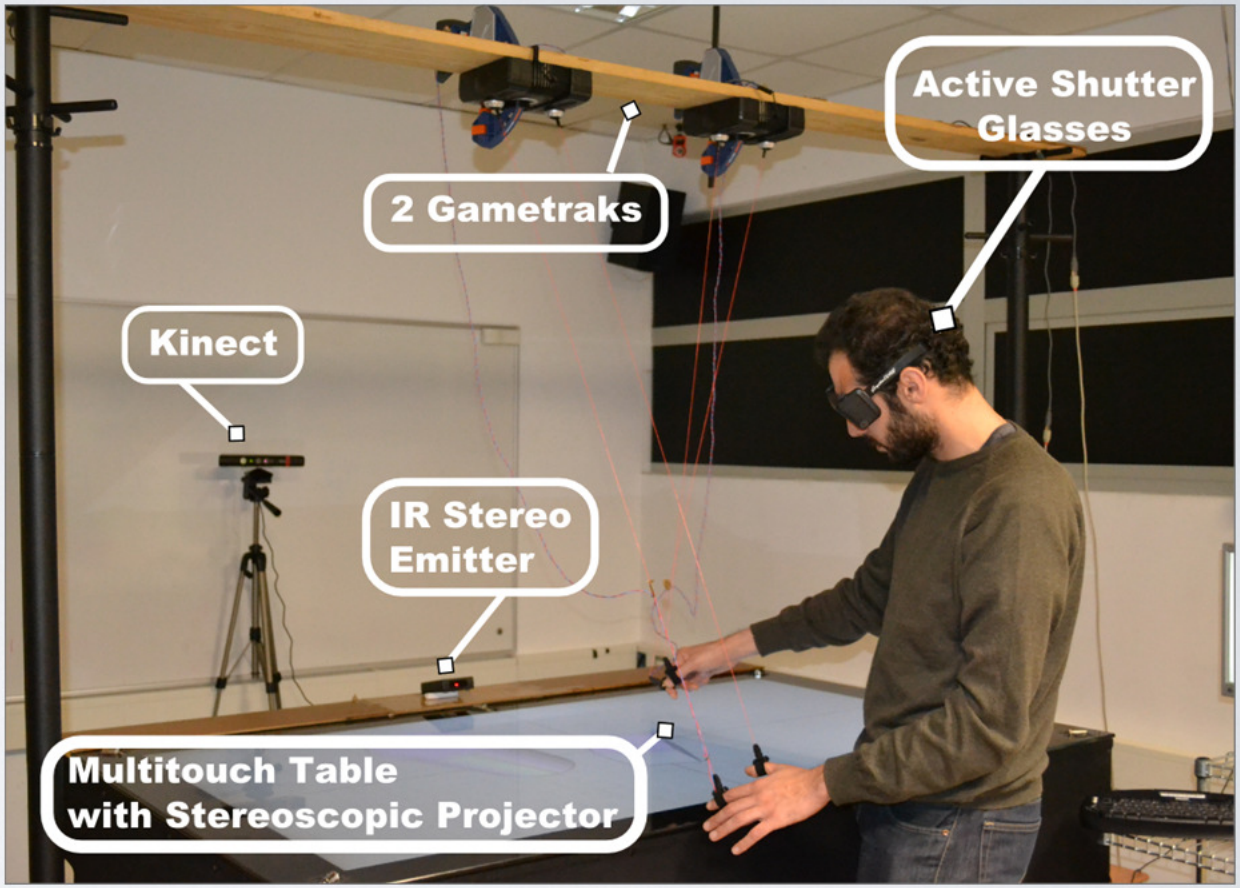
PUTTING ALL TOGETHER
3D I/O TABLETOP

Interaction and Visualization Spaces

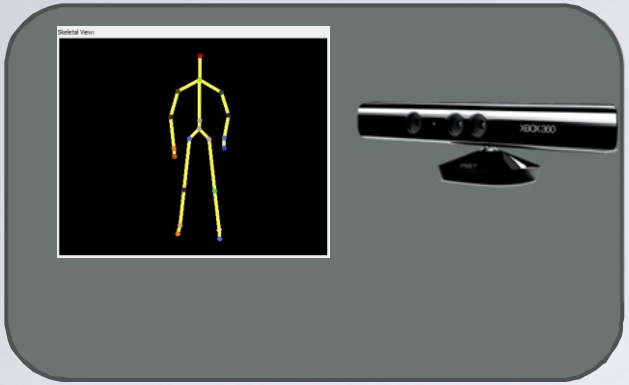


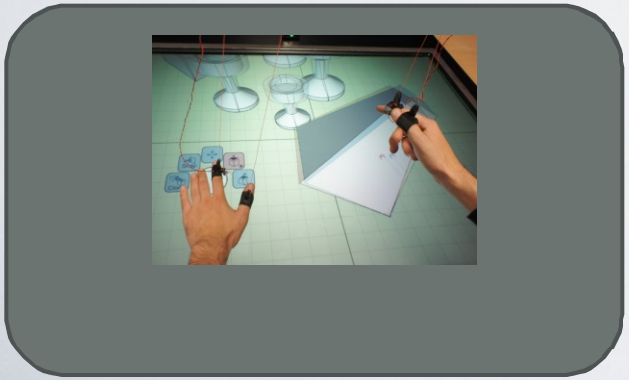
Setup Examples

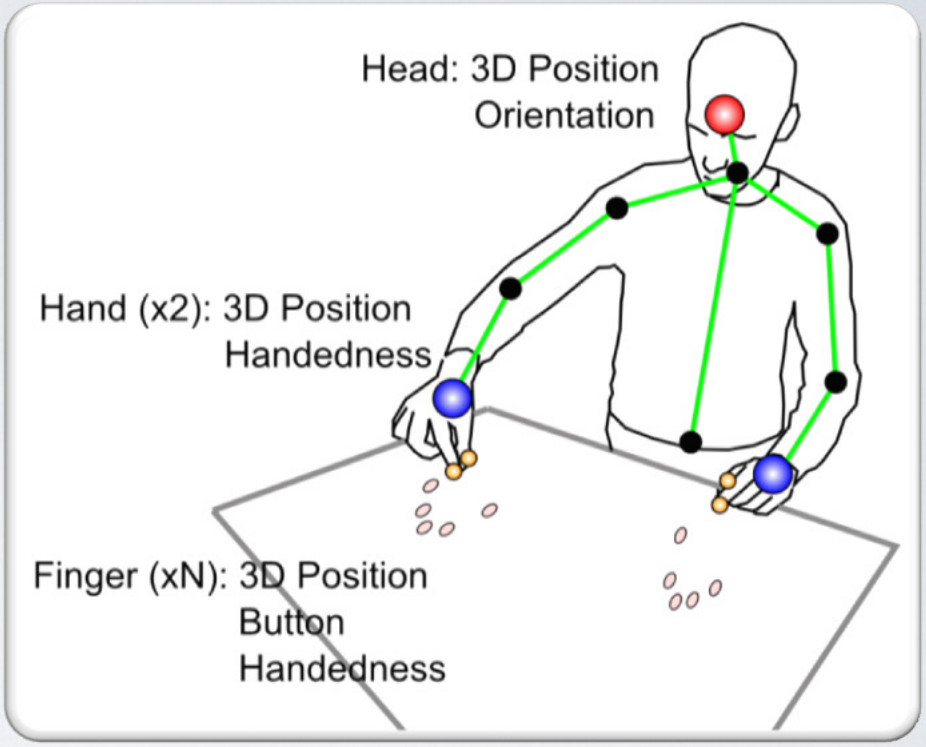




Creating a Unique User Model

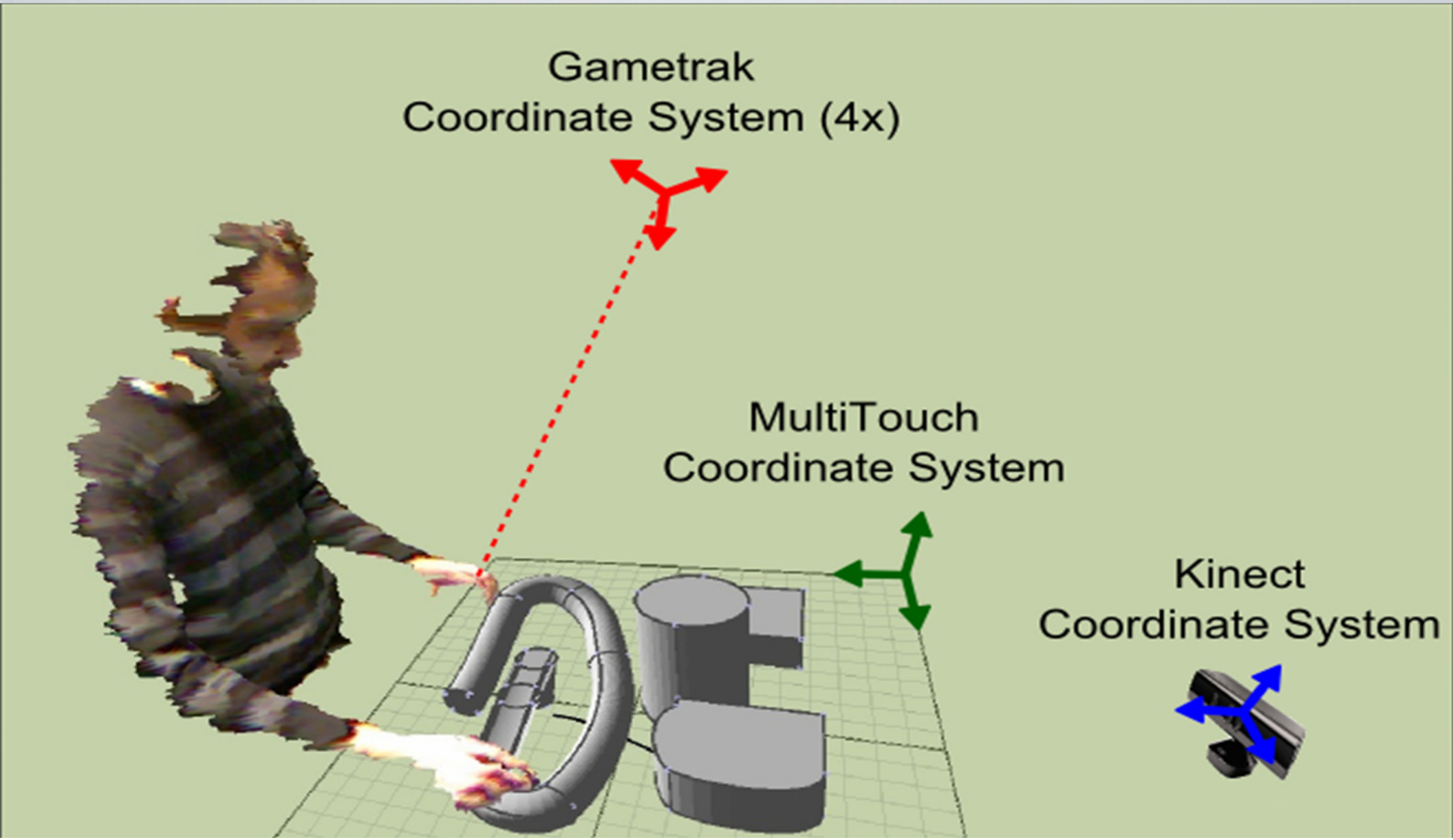




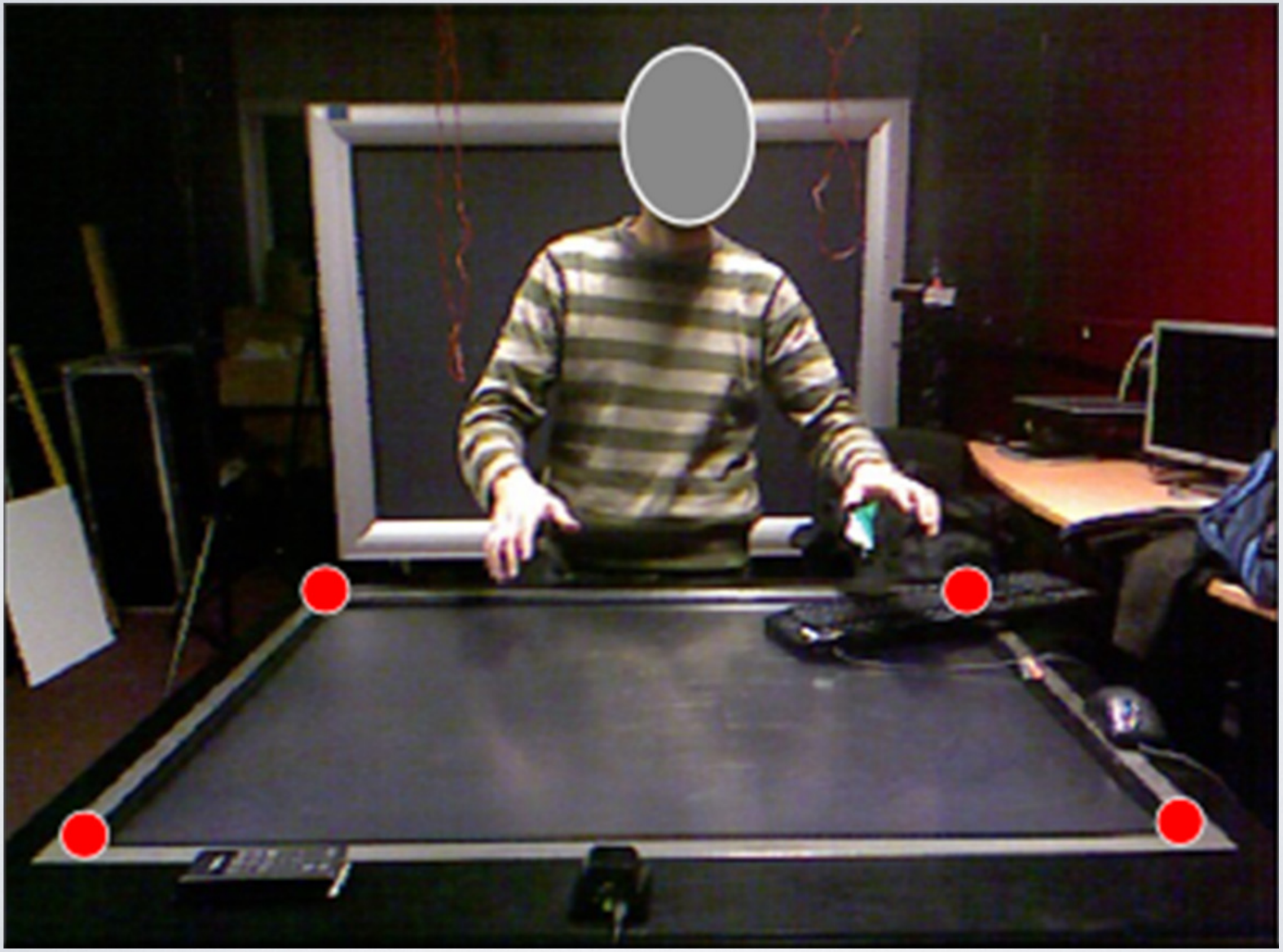


Finger **X** from Hand **Y** on or above the surface from user **Z**

Multiple Coordinate Systems



Multi-Touch to Kinect Space



Gametrak to Kinect Space

Surface Sampling
Collecting 1k pairs

2D touch raw data
3D Gametrak raw data

2D touch to 3D touch
Conversion

3D touch data
3D Gametrak raw data

Compute 6 DoF Rigid
Transformation [Fischler81]

Transformation Matrix

4 x
(1 per string)