Touch Technologies

Touching the World

by Sara Kilcher

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sakilche@student.ethz.ch

ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Motivation

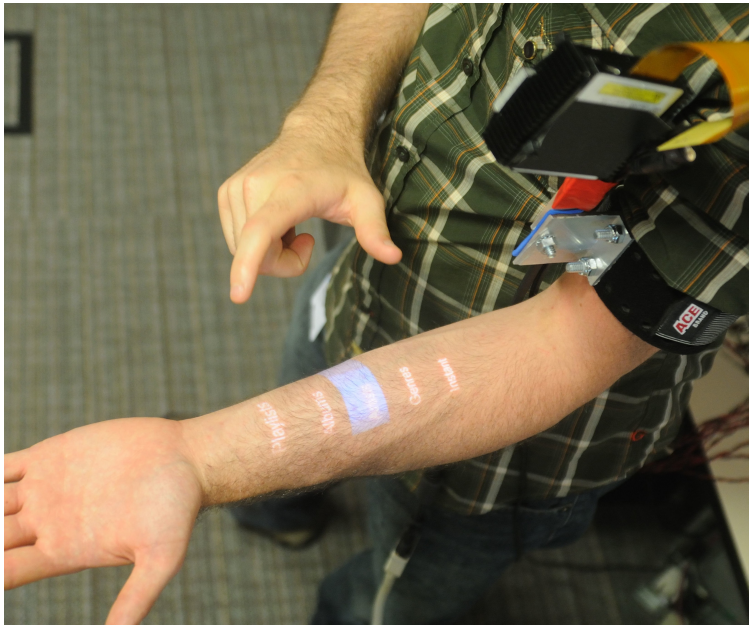

Project
Costs
CD
Collateral
Advertising
PR
on target


98


SONY
PS VITA

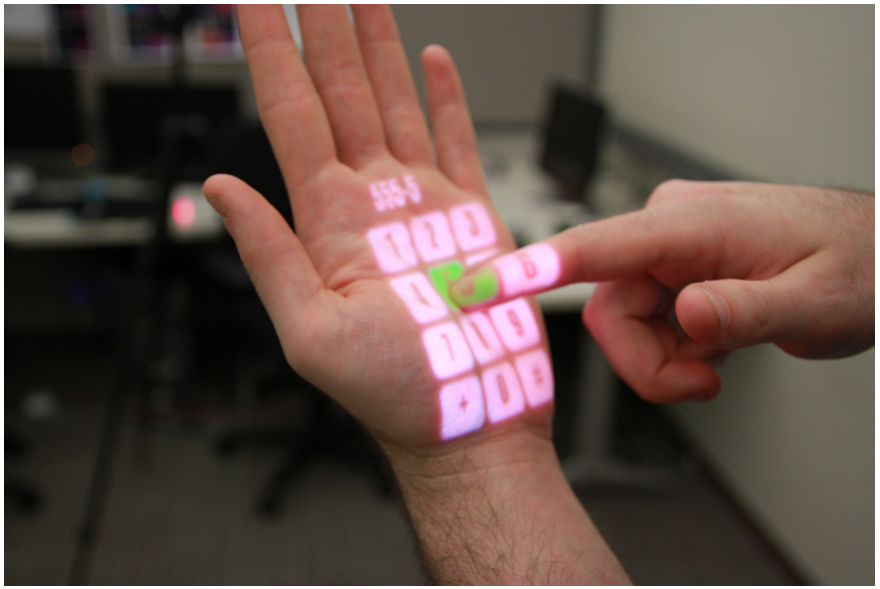
Overview

- Skin as touchscreen
  - Skinput



Overview

- Skin as touchscreen
  - Skinput
  - OmniTouch



Overview

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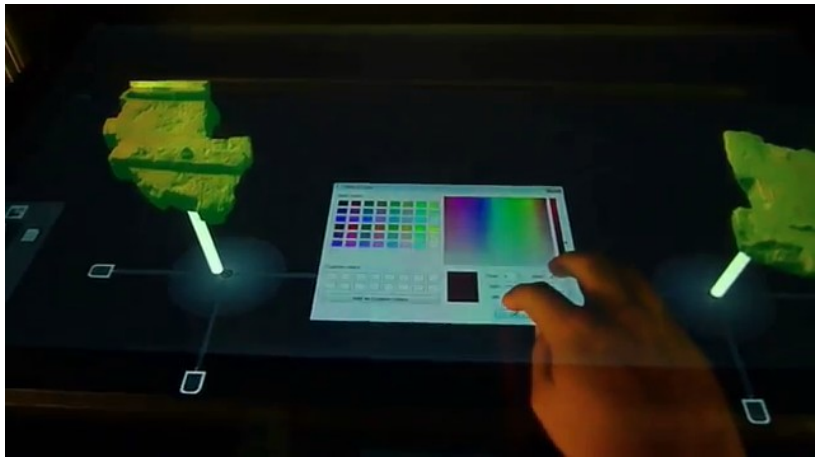


- Touchscreen for virtual 3D
  - Toucheo

Skin as Touchscreen

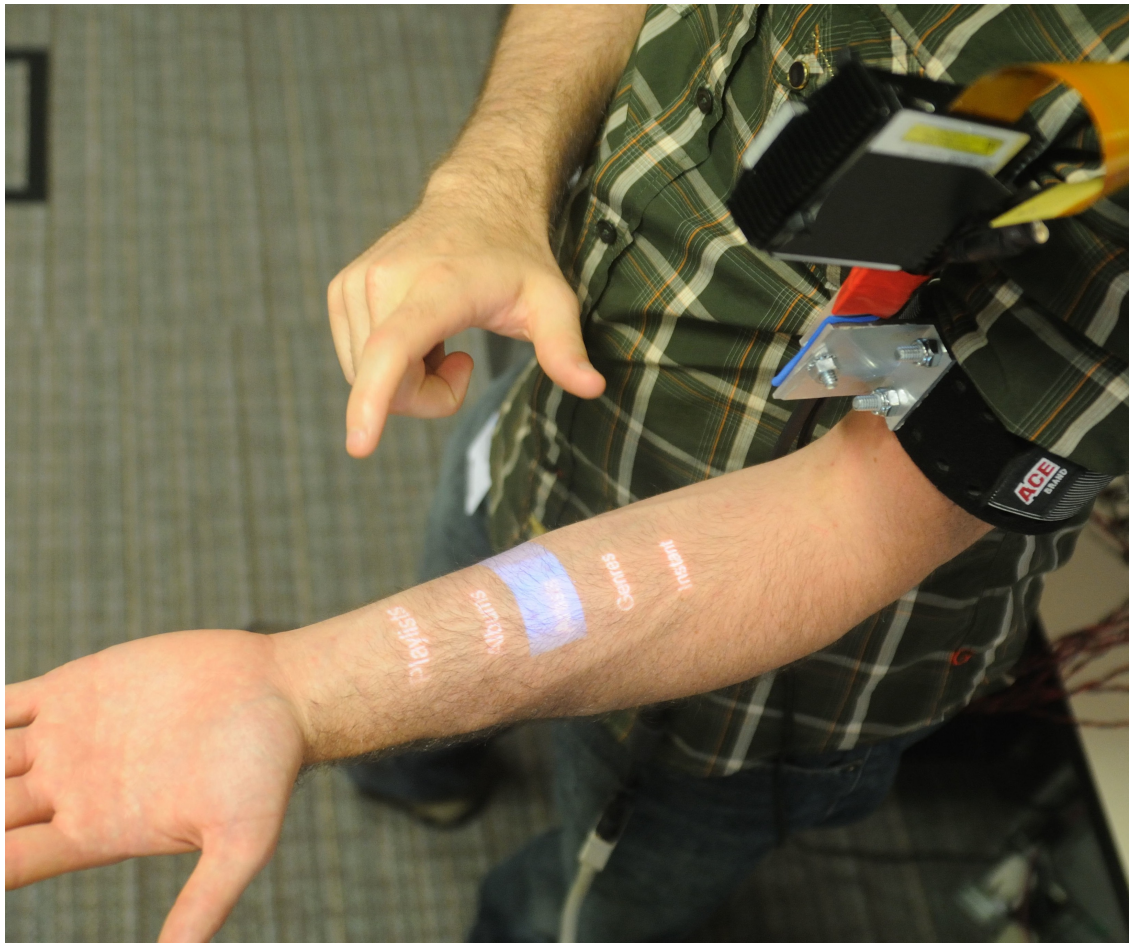
Introduction

- Mobile phones like computers
- Small screen/keyboard size

User becomes bottleneck

Harrison et al. 2010

Skinput



Purpose

- Extend interface

- Using skin

Video

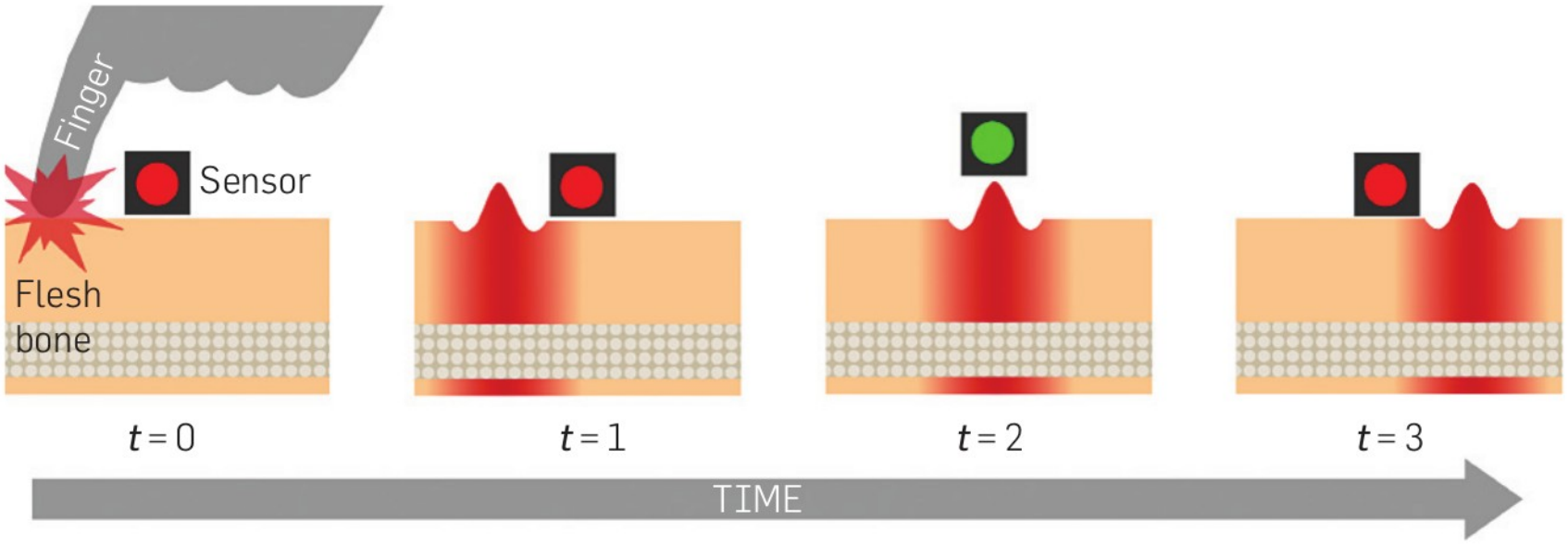
Video: 01_skinput.avi

Difficulty

- Touch → where?

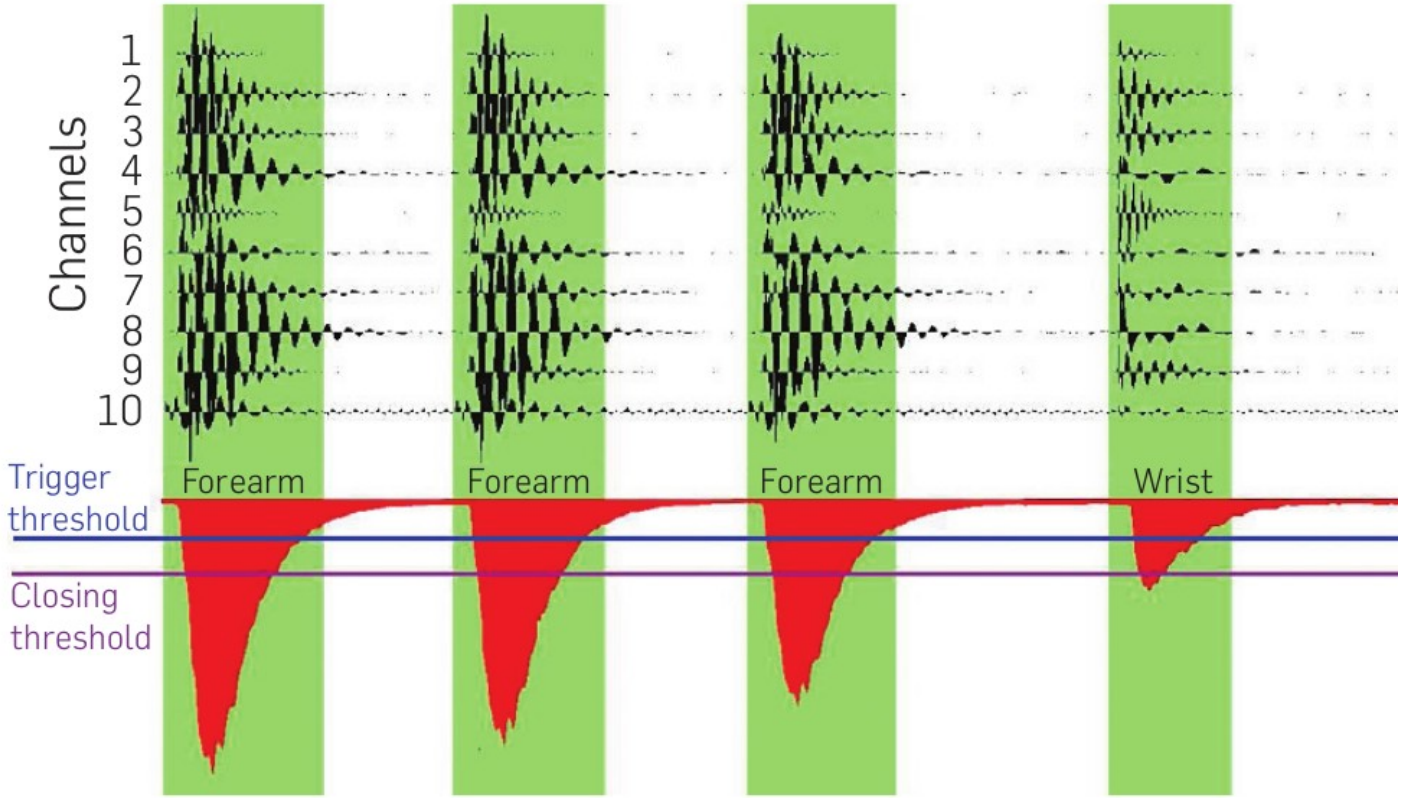
How it works

The Waves



How it works

Processing the Waves



How it works

Training SVM

Video: 02_skinput.avi

How it works

Recognition

Video: 03_skinput.avi

How well it works

- User study with 13 participants
- Touch event errors “negligible”
- Position not very accurate
  - Overall 87.6% (5 to 10 locations)
  - Up to 95.5% (5 locations)

How well it works

Video: 04_skinput.avi

Personal Opinion

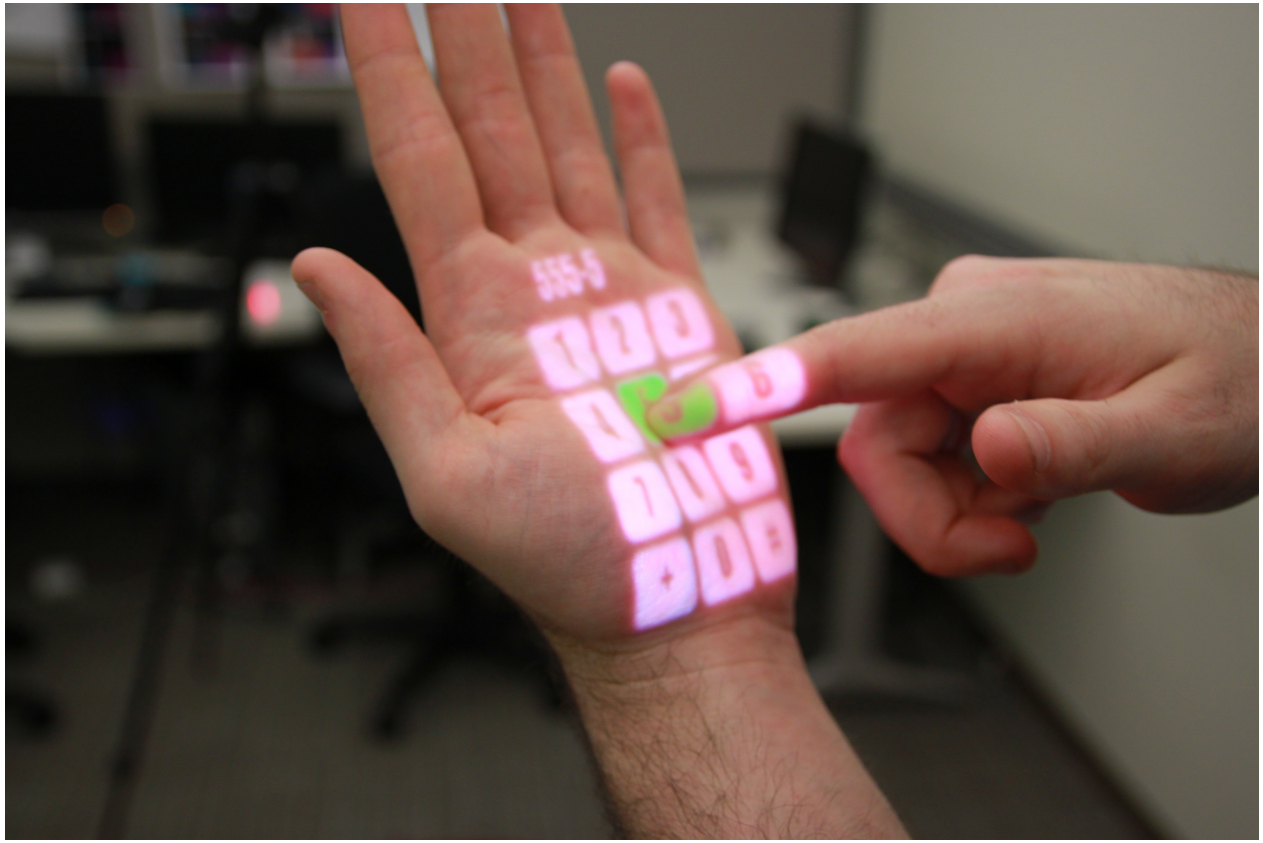
- Very innovative
- Requires lots of calibration
  - Did not work well in demos
- Lots of “magic” that isn't entirely understood
  - Hard to tune → gesture recognition?
  - Completely individual

Vision

- Armband will get smaller
- Use cases without projector
  - Car
  - Jogging
  - Audio Feedback?

Harrison et al. 2011

OmniTouch



Purpose

- Like Skinput, but
  - Needs a projector
  - Needs a depth-camera
  - Can be used on additional flat surfaces

Video

Video

Video: 05_omnitouch.avi

Difficulties
Projection

- Surface is uneven
  - Distortion
  - Focus
- Surface is moving
  - Tracking

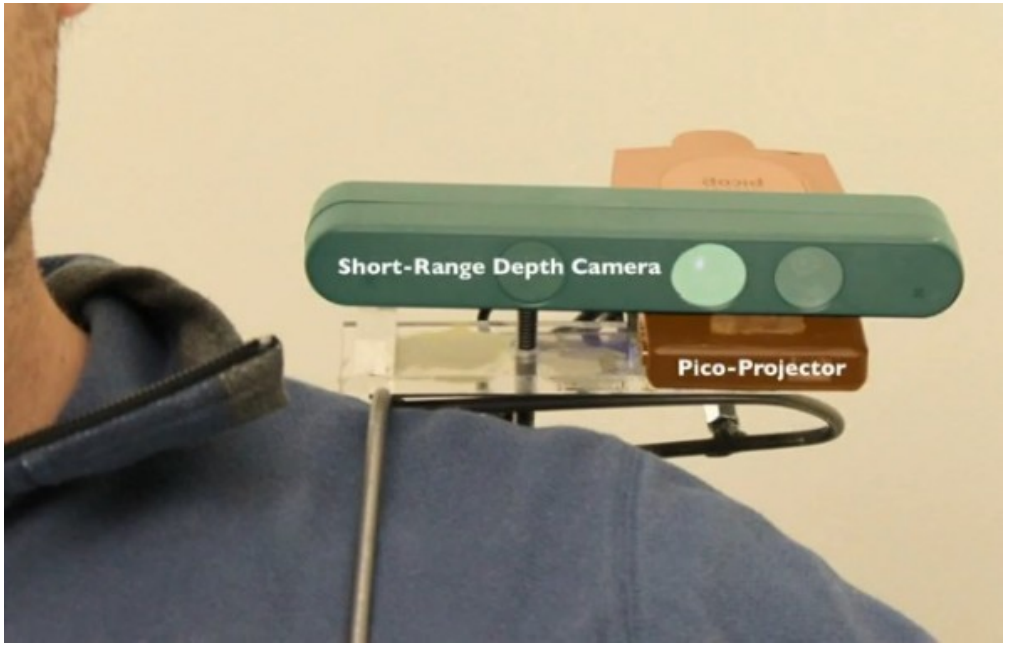
Difficulties

Input Recognition

- Touch event recognition
  - Touch → when?
  - Touch → where?

How it works

The Hardware



How it works

Recognition of Fingers

Step 1:

Depth map of scene

How it works

Recognition of Fingers

Step 2:

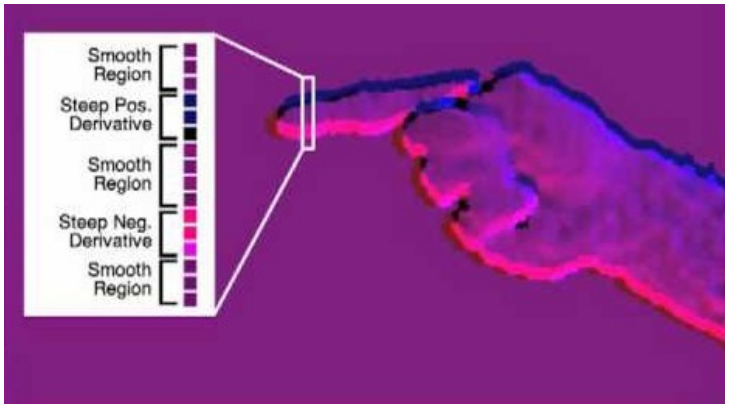
Derivatives

How it works

Recognition of Fingers

Step 3:

"Template matching"



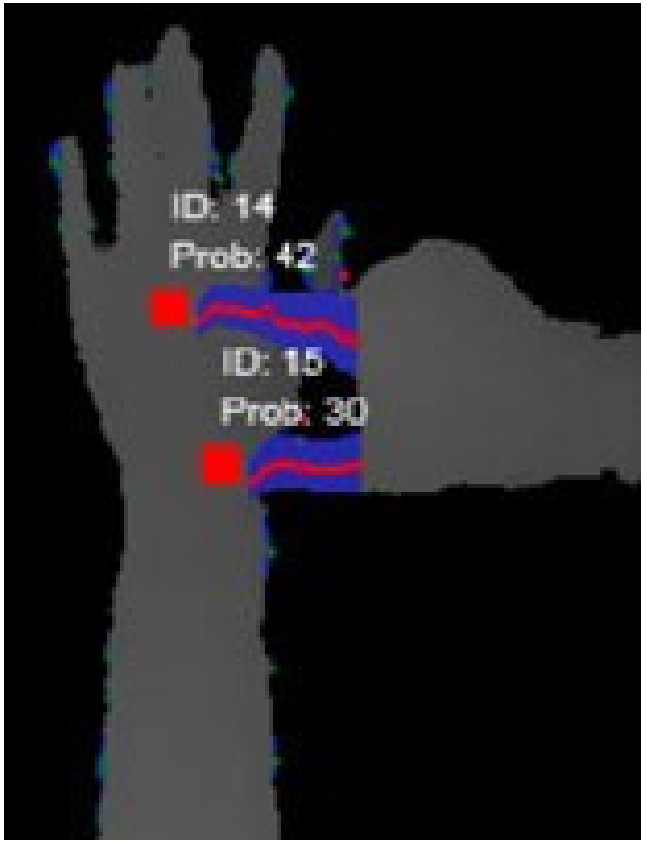
How it works

Recognition of Fingers

Step 4:

Group slices &

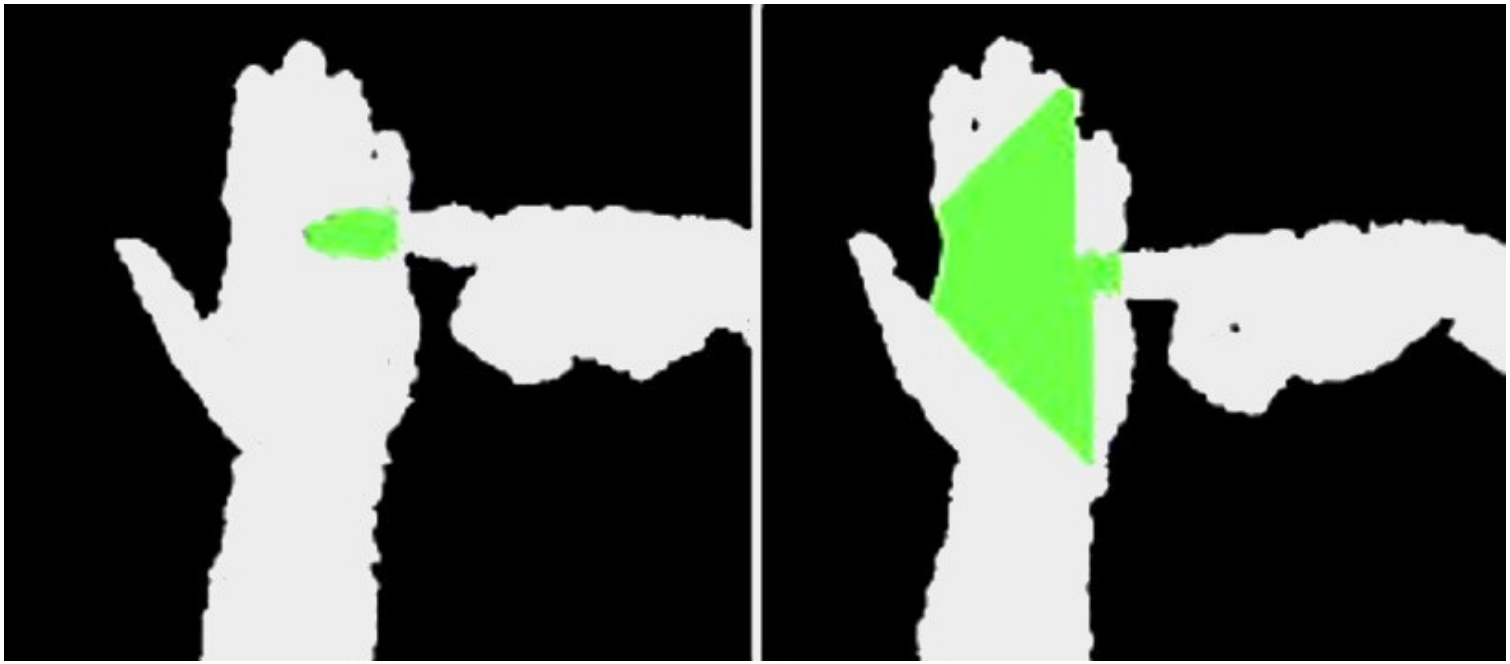
find fingertips



How it works

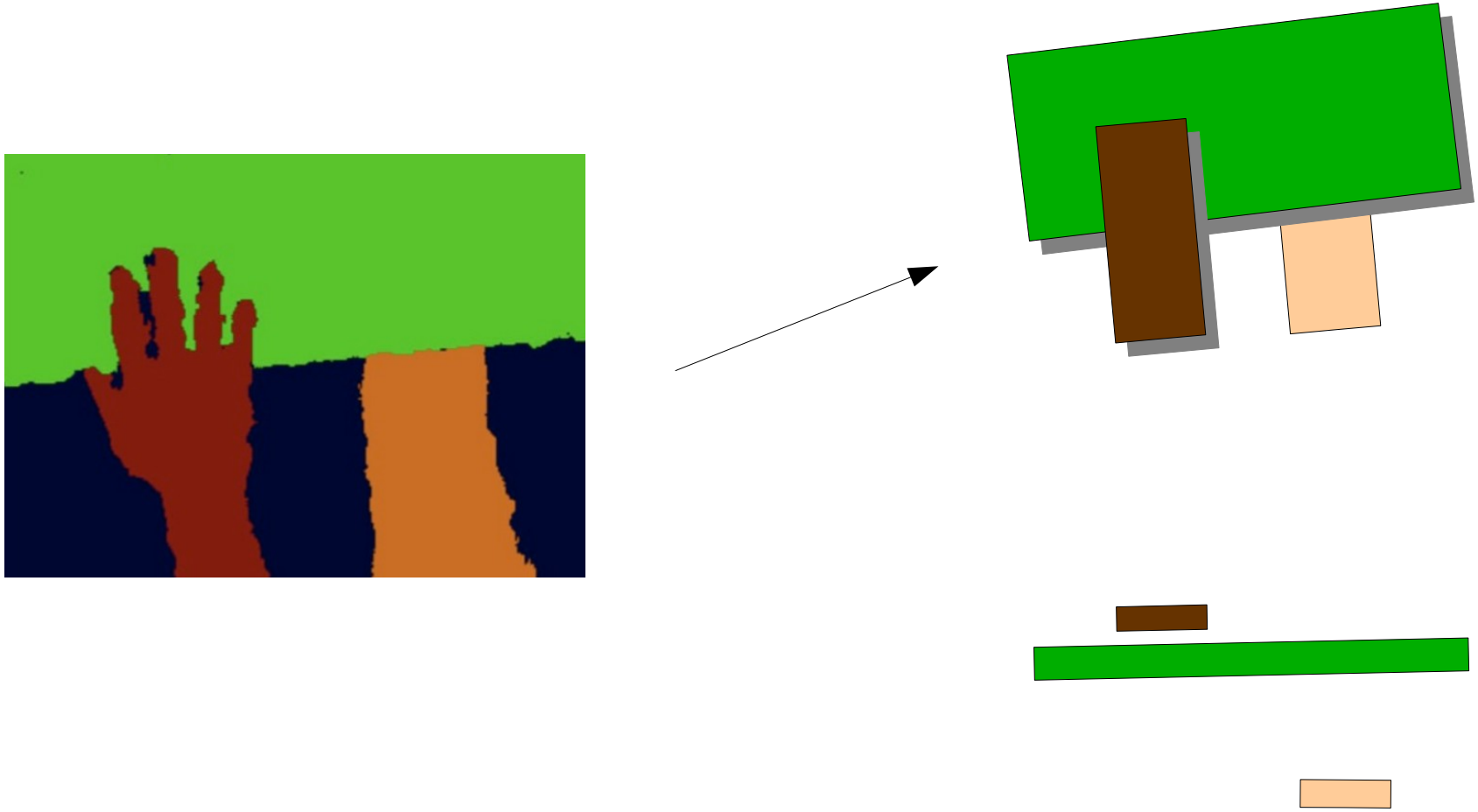
Recognition of Touch Events

Flood fill the finger



How it works

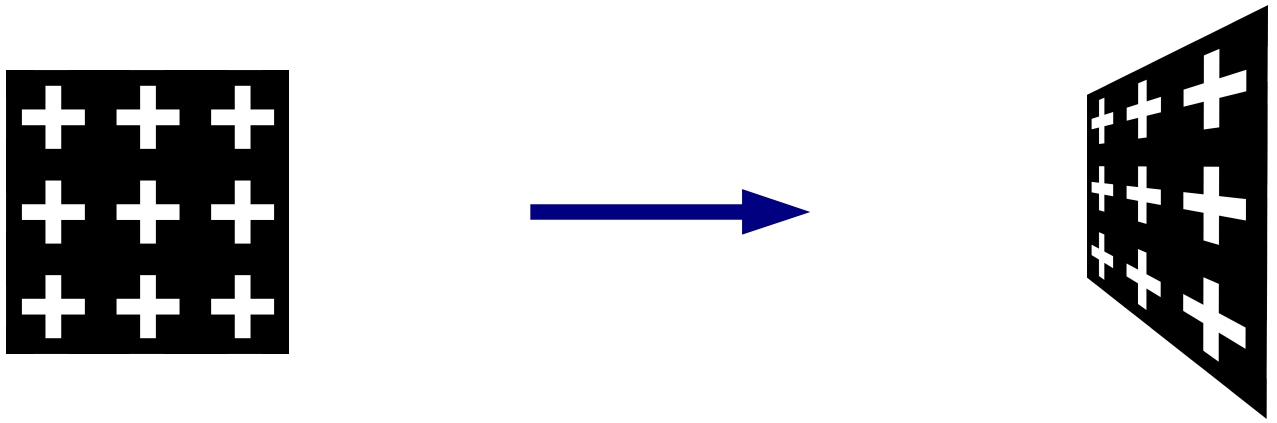
Recognition of Surfaces



How it works

Displaying Interfaces

- **Projective texturing**



How well it works

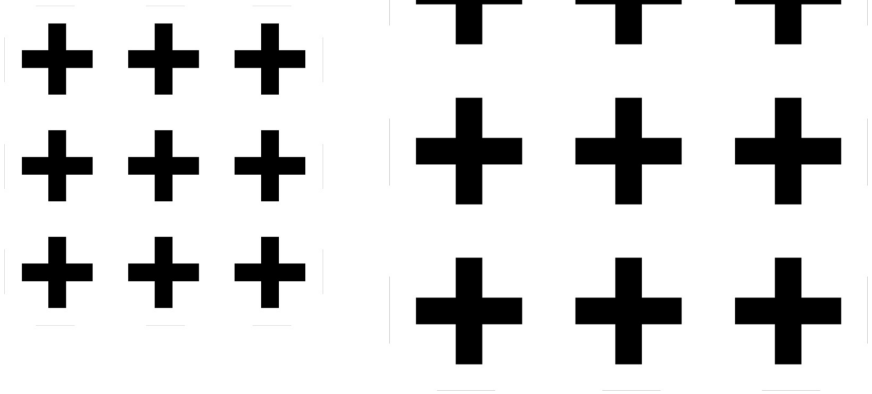
Click Accuracy

- **User study with 12 participants**
- **Click recognition: 96.5%**

How well it works

Location Accuracy

Touchscreen: 15mm



Omnitouch, hand: 25mm

Personal Opinion

- Fascinating paper
- Popular on web
- No real applications yet
- Use self-made algorithms
  - possible to improve

Vision

- Entire world as touchscreen
- Device will get smaller and more comfortable

Skinput OmniTouch

- Touch accuracy
- Use cases without projector

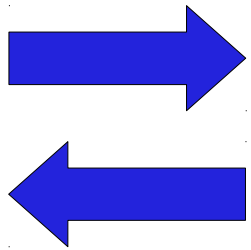
- Location accuracy
- Use more surfaces
  - More applications

Skinput OmniTouch

- "Impact" press needed
  - No long press
  - No dragging
- Setup & calibration
- Stable arm position
- Predefined points

- Finger detection
- Where to place hardware?
- Bright light

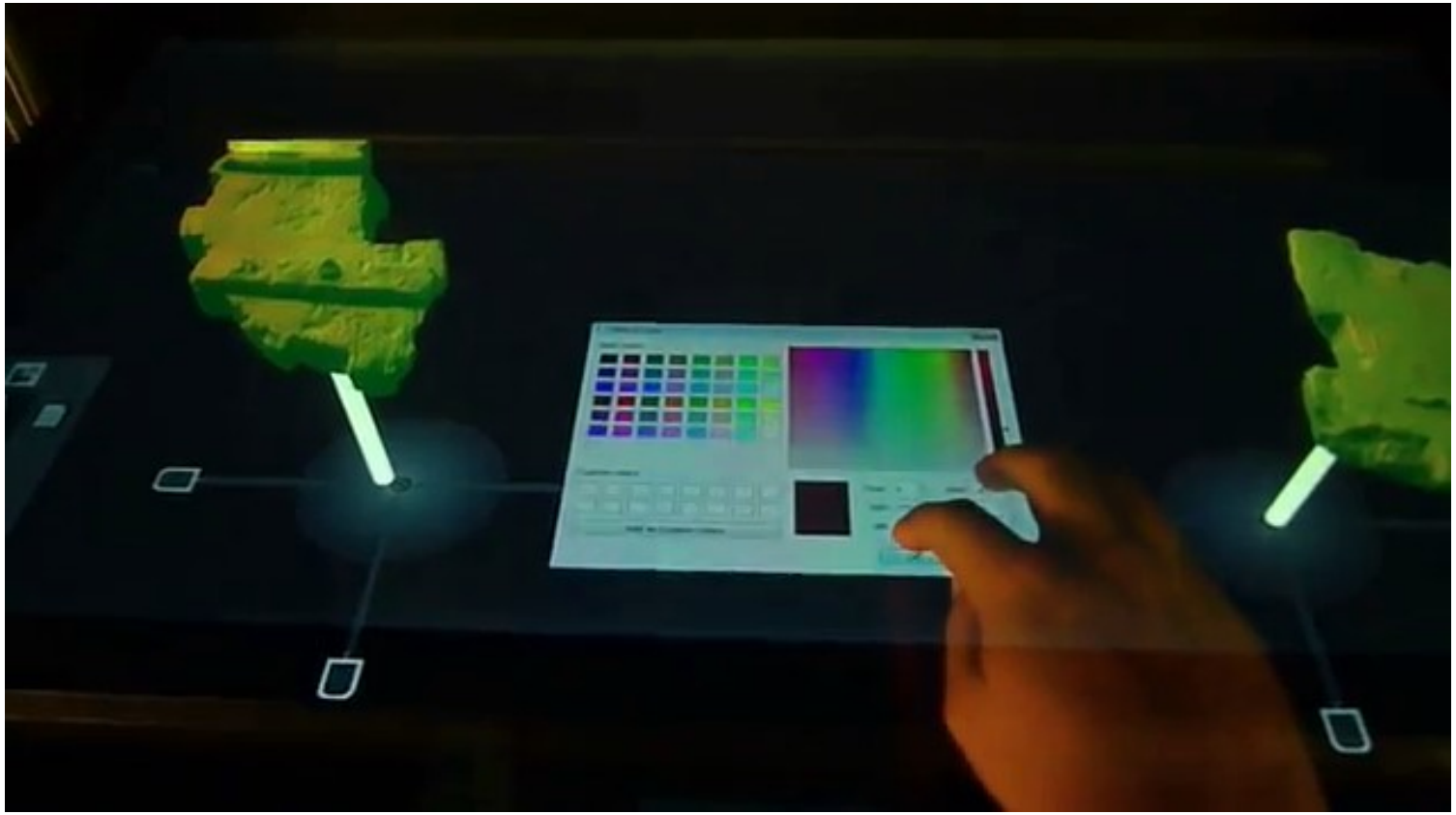
Touchscreen ⇔ World



Skinput | OmniTouch | Toucheo

Hachet et al. 2011

Toucheo

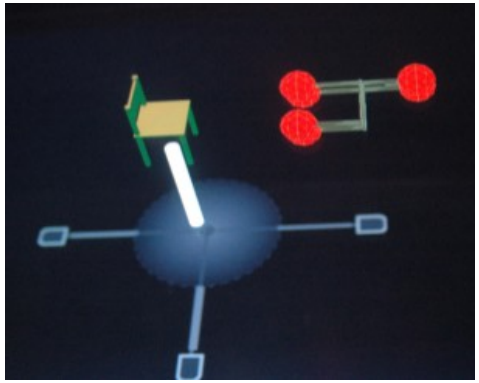


Purpose

- Merge trends
  - Multitouch touchscreen
  - Stereoscopic screen

Easy interaction with virtual 3D objects!

- Solve difficult tasks
  - e.g. 3D docking task



Video

Video

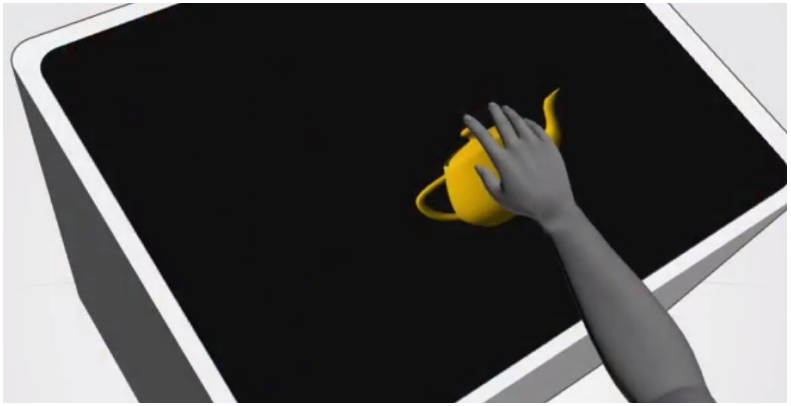
Video: 06_toucheo.avi

Video: 07_toucheo.avi

Difficulties

3D and the Hands

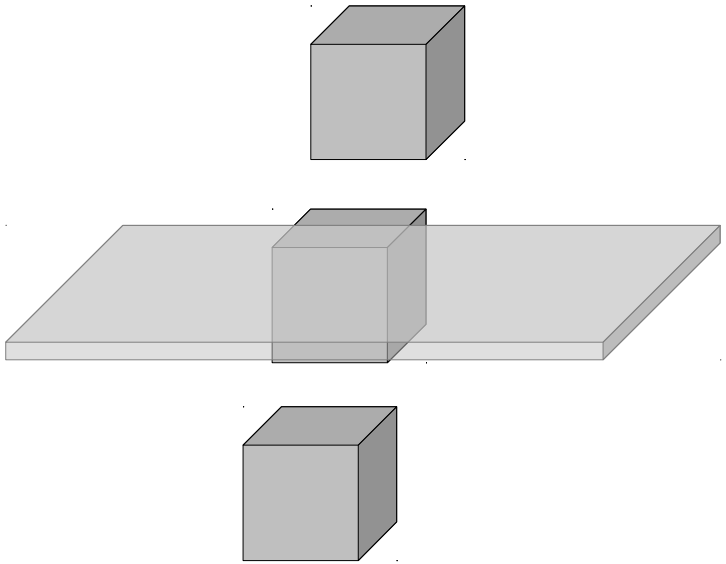
- Occlusions



- Depth collision

Difficulties
Eye Related

Contradiction

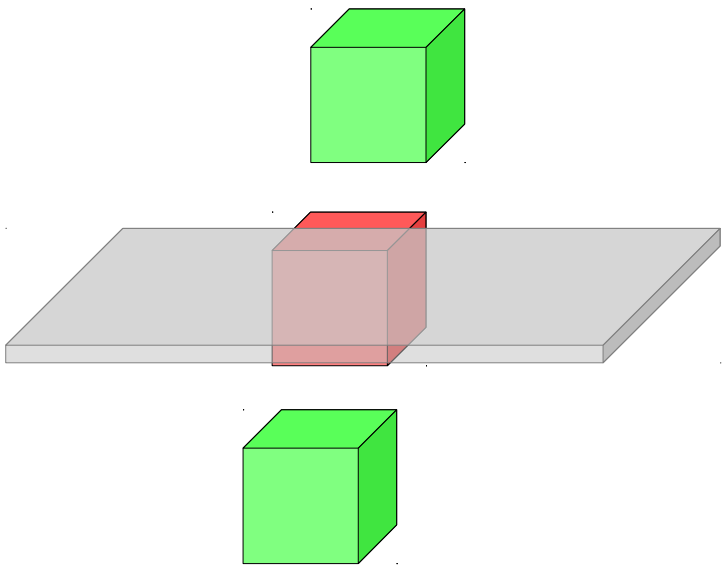


Difficulties
Eye Related

Contradiction

- 3D useful

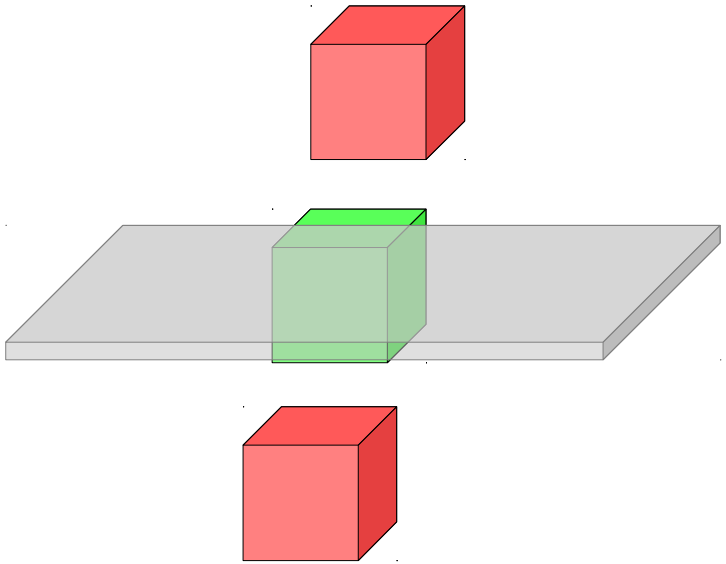
  above/below plane



Difficulties
Eye Related

Contradiction

- 3D useful
  above/below plane
- Touchscreen only
  in plane



Difficulties

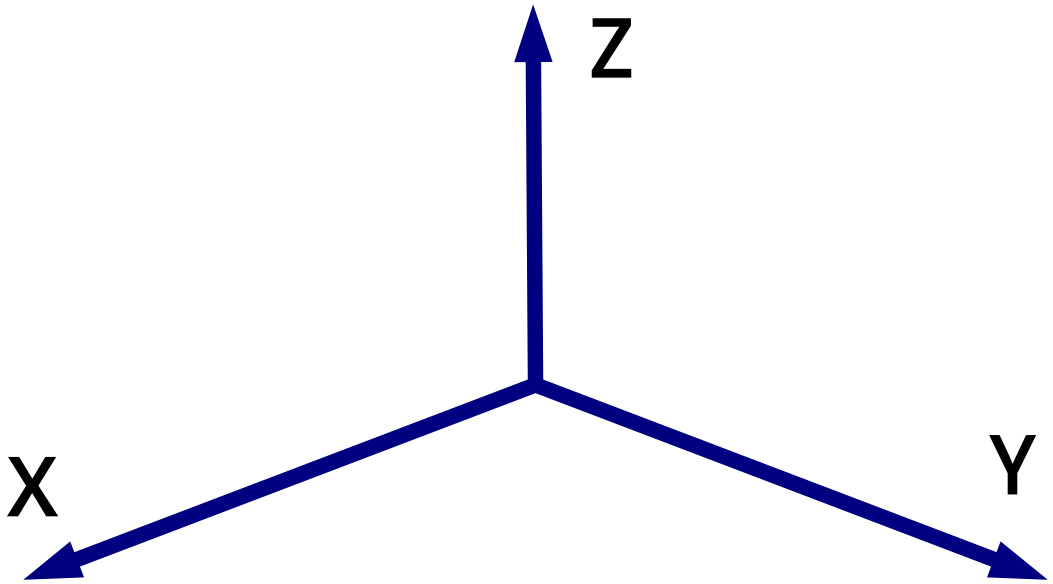
Usable Interface

- **Typical smartphone has 3+1 DOF, Toucheo has 9+1**
- **Intuitive interface?**

Difficulties

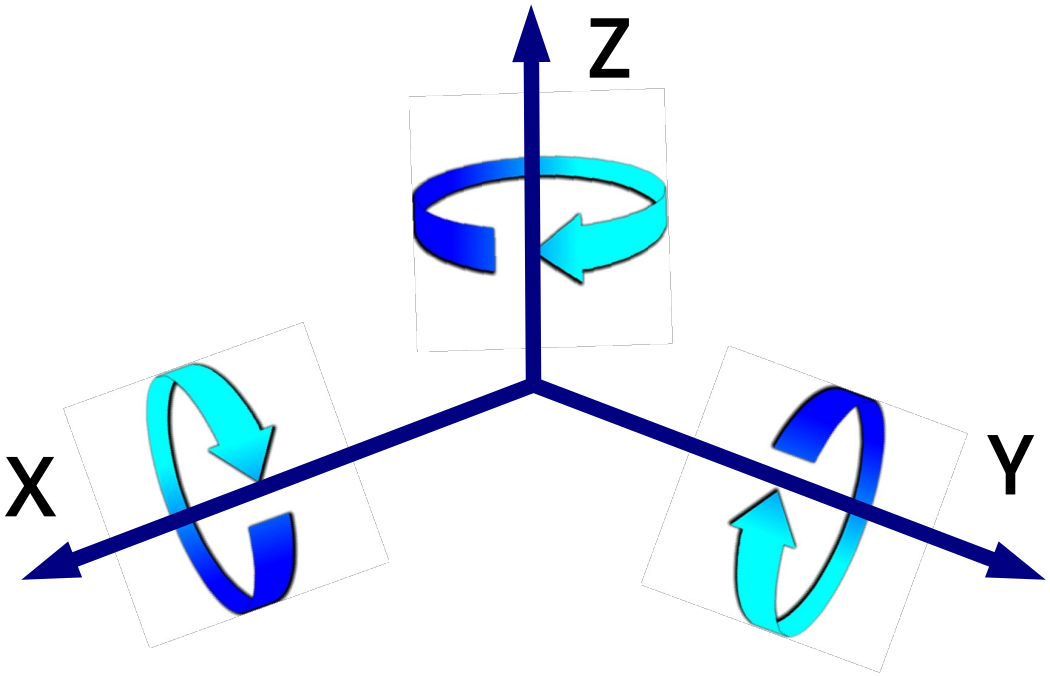
The 9+1 DOF

Translation: 3 DOF



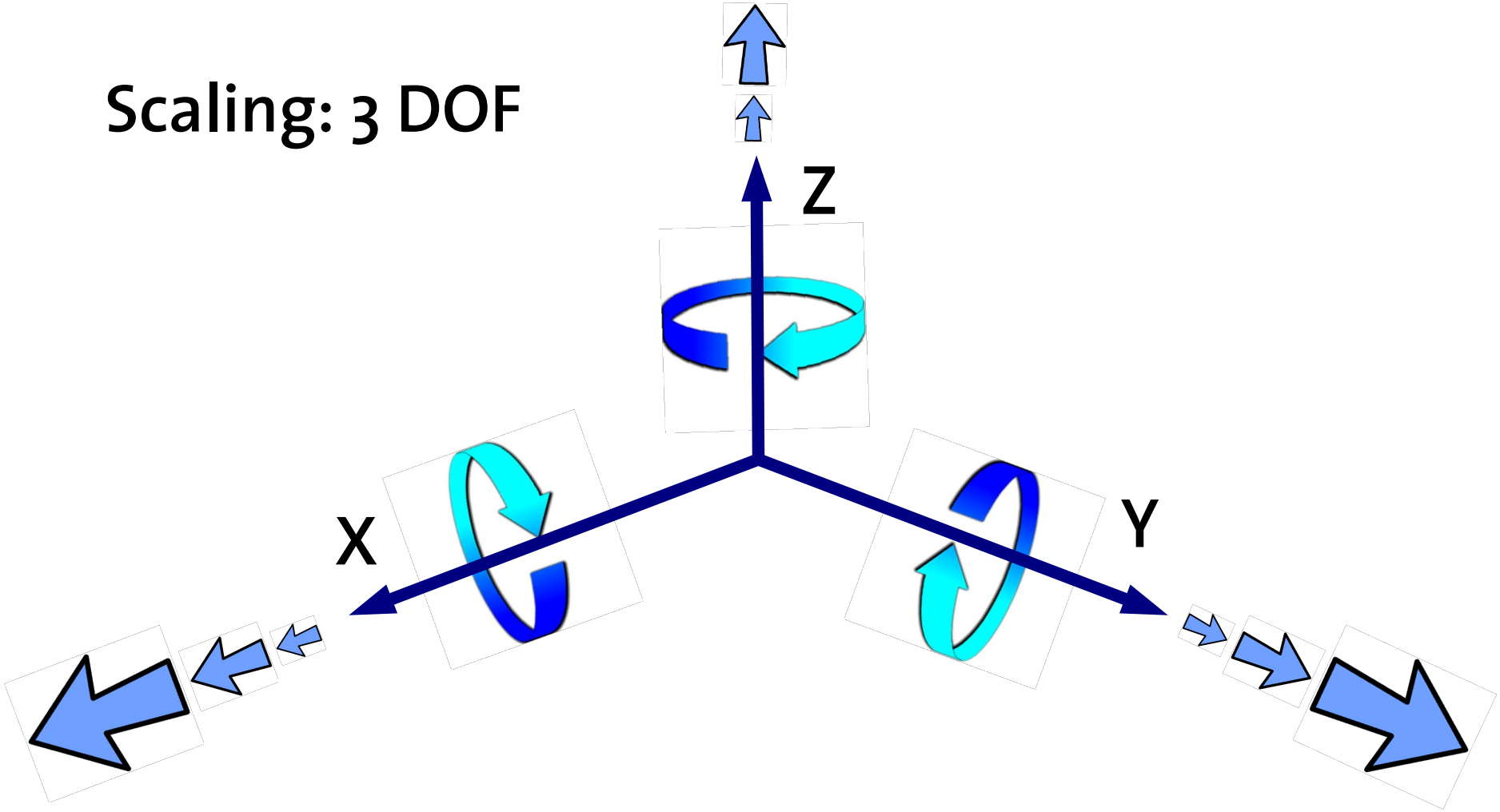
Difficulties
The 9+1 DOF

Rotation: 3 DOF



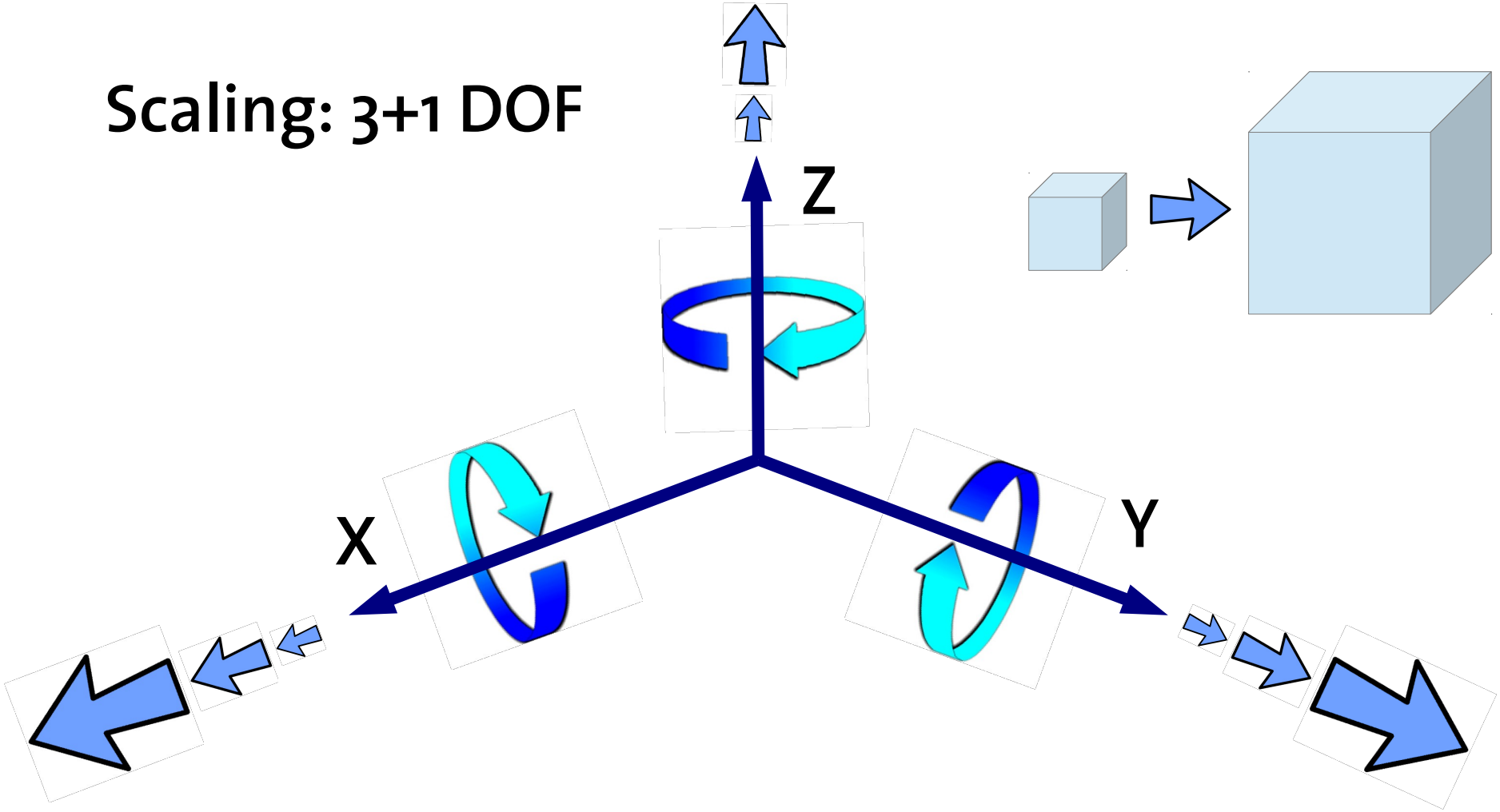
Difficulties
The 9+1 DOF

Scaling: 3 DOF



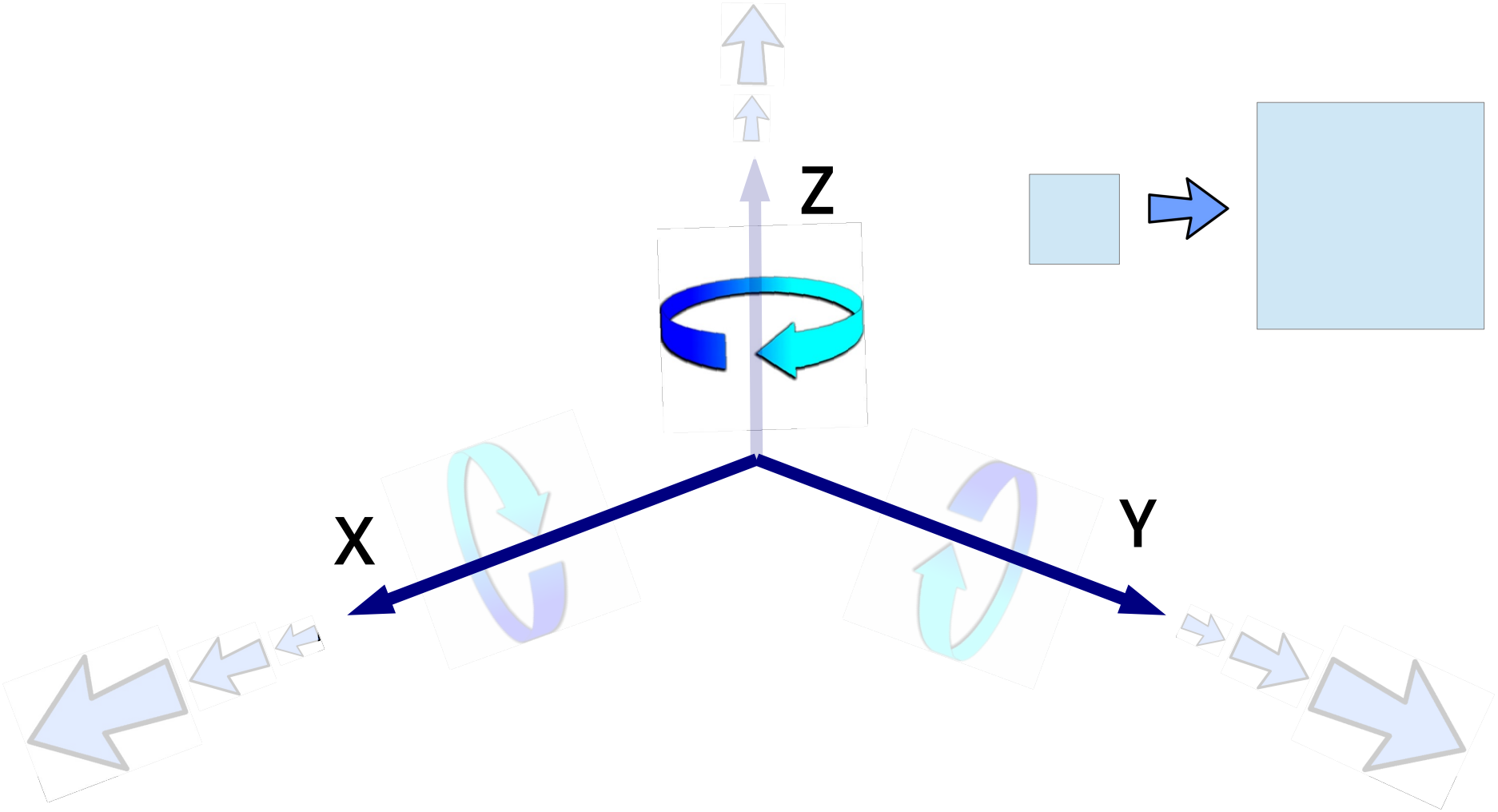
Difficulties
The 9+1 DOF

Scaling: 3+1 DOF



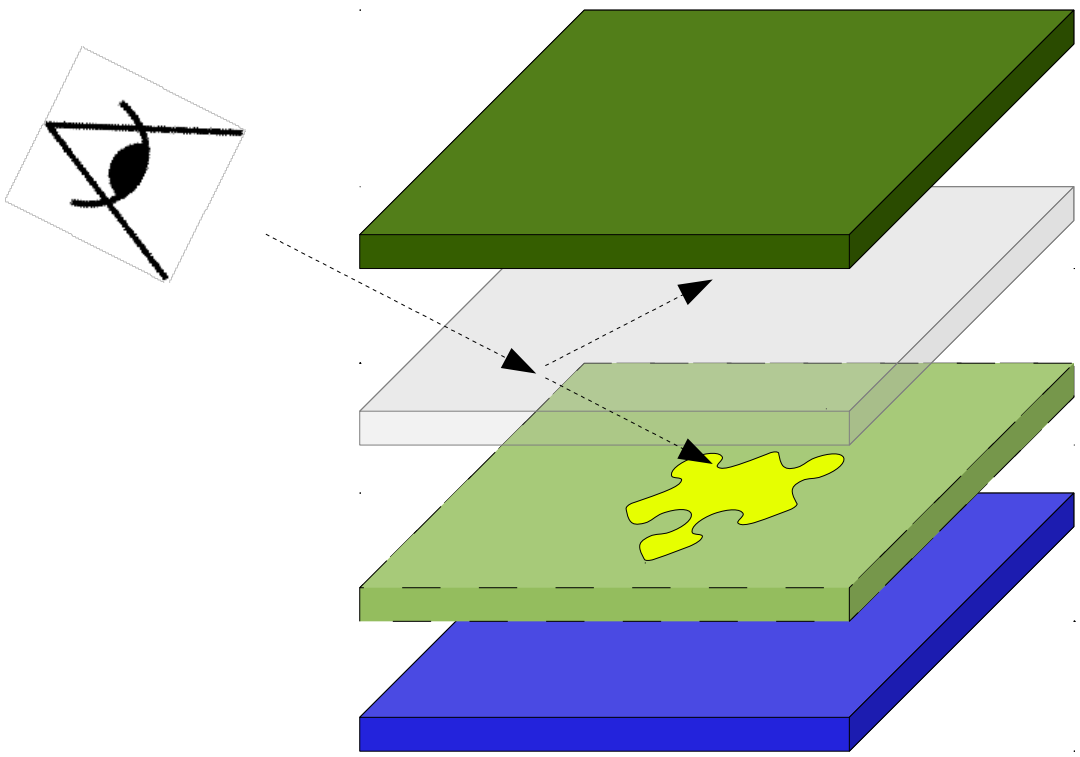
Difficulties

Smartphone: 3+1 DOF



How it works

The Setup



How it works

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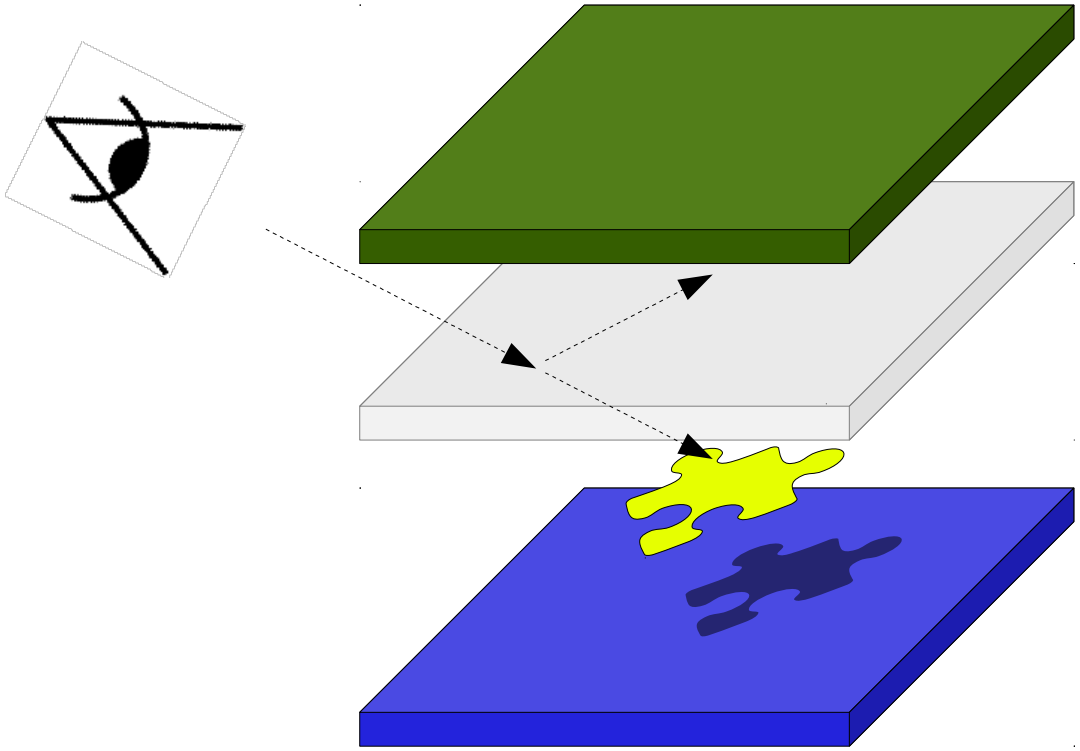


Screen

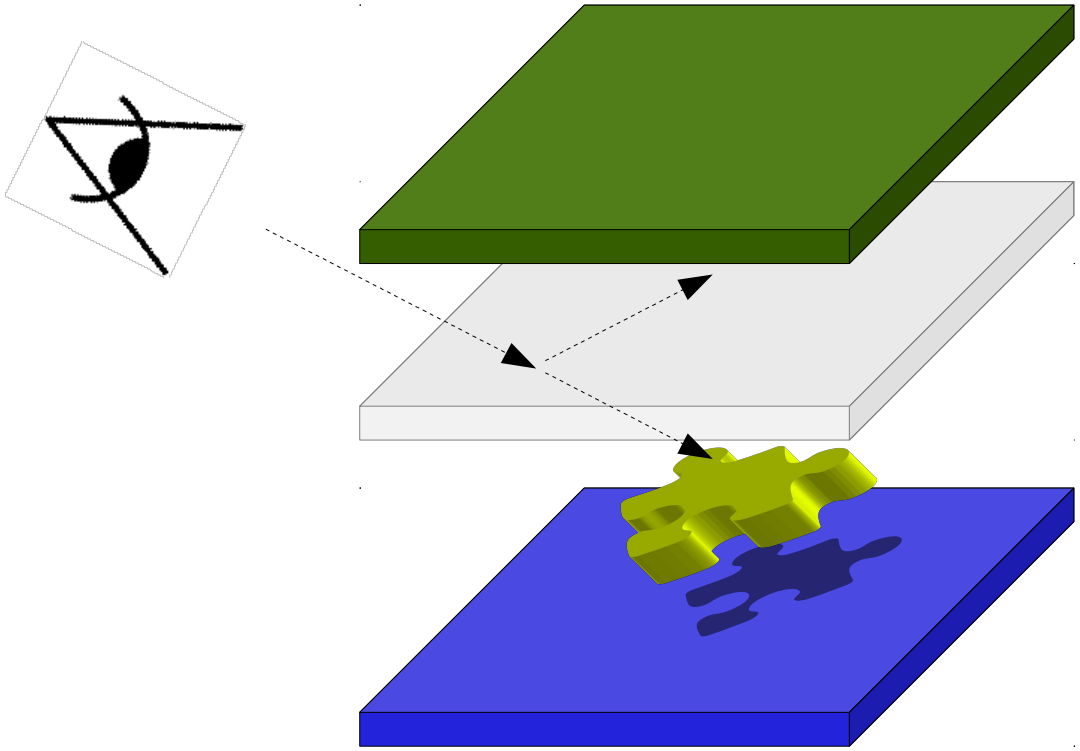
Mirror

Mirrored Screen

Touchscreen

How it works

The Setup



3D Screen

Mirror

Mirrored 3D Screen

Touchscreen

How it works

The Setup

How it works

The Setup

- Occlusion problems eliminated
- Depth collision problems reduced

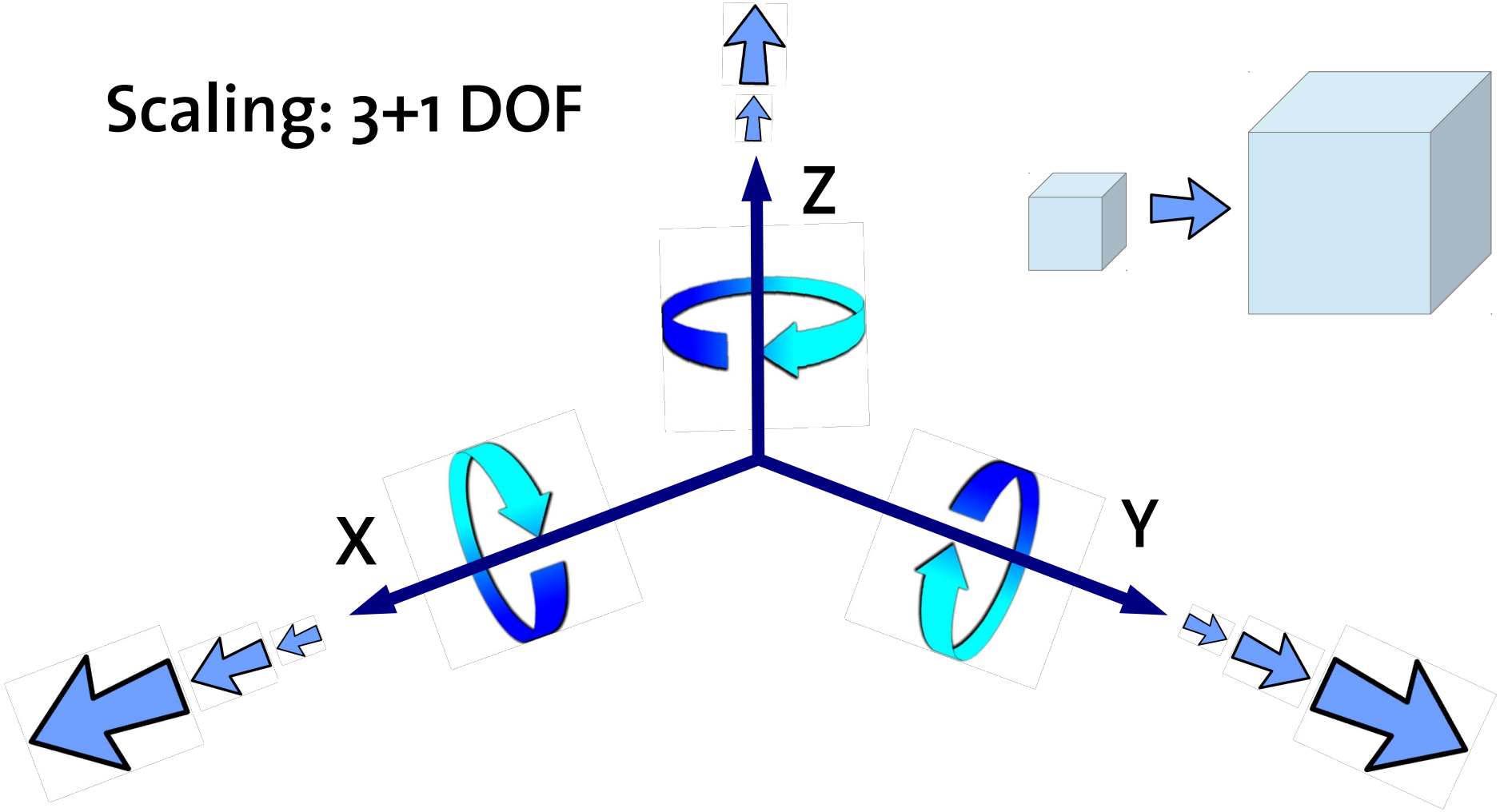
How it works

3D to 2D - „Virtual Ray”

How it works

The 9+1 DOF

Scaling: 3+1 DOF



How it works

The 9+1 DOF

Video: o8_toucheo.avi

How well it works

- User study, 16 participants
  - Bulky, quite big
  - 3D-docking task solved well
  - Feedback used to improve interface

Personal Opinion

- **Clever setup to solve common problems**
- **Interface: independent achievement**

Vision

- Interface used in other applications
- New generation less bulky

Toucheo	OmniTouch / Skinput
Touchscreen	
Touch of non-planar objects	
Virtual 3D objects	Real 3D objects
Input from traditional touchscreen	Input from camera / vibration sensors
How to use touch events	How to get touch events
Novel GUI	Standard GUI
Display with stereoscopic screen	Display with pico-projector
Static / big	Mobile / small

Displays of the Future

- Assumption
  - Increase in screen size = increase in device size
- Alternative
  - Displays → non-planar surfaces
- Market direction?

Displays of the Future

Video: 09_future.avi

Video: 10_future.avi

Video: 11_future.avi

Video: 12_future.avi

Video: 13_future.avi

Video: 14_future.avi