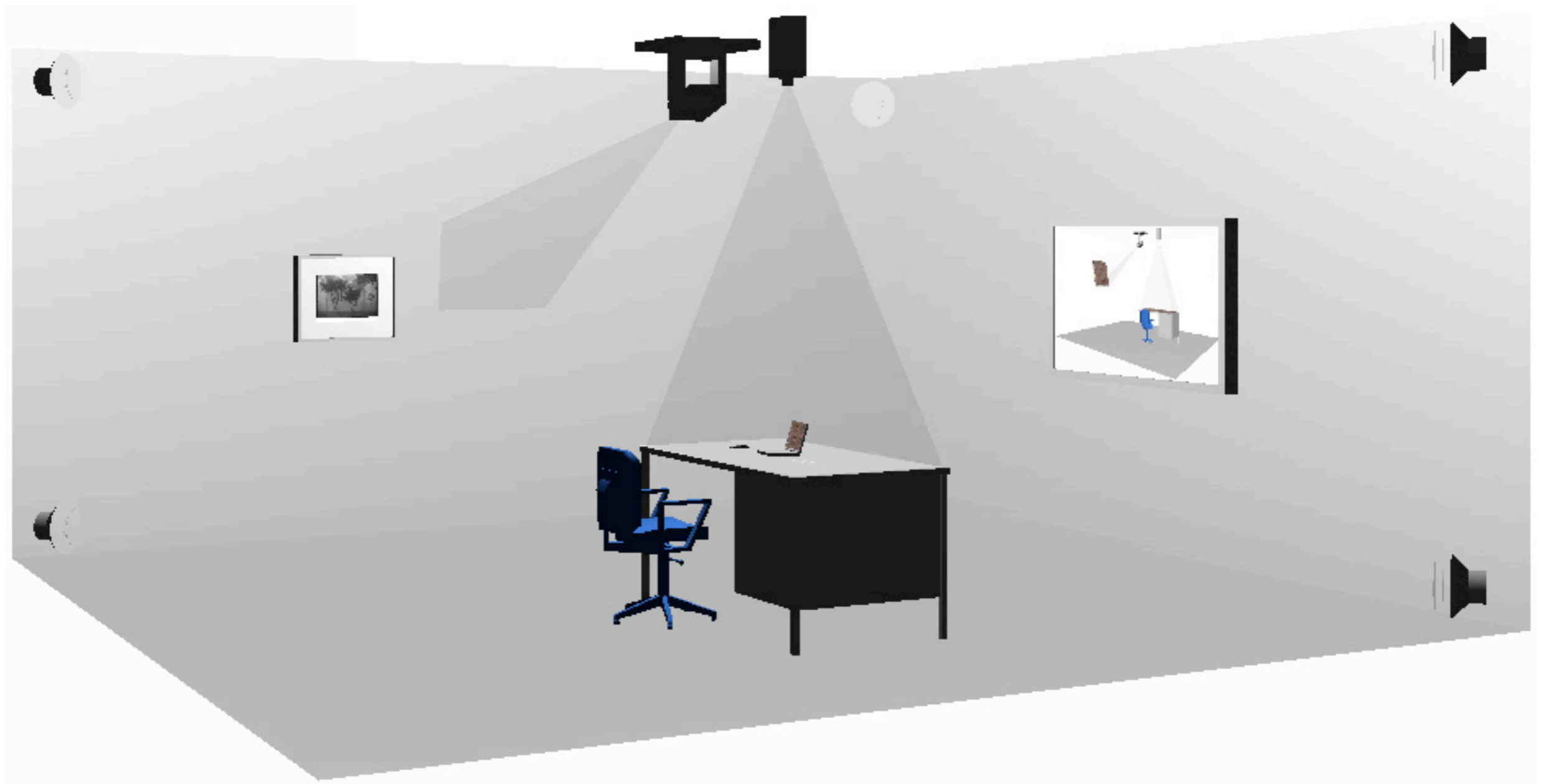


# Instrumented Environments

Andreas Butz, [butz@ifi.lmu.de](mailto:butz@ifi.lmu.de), [www.mimuc.de](http://www.mimuc.de)



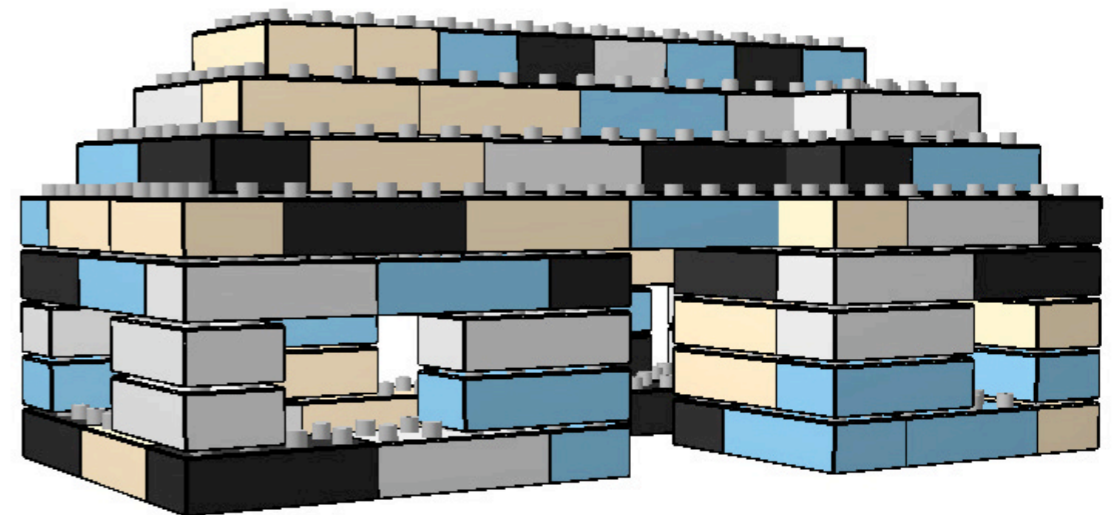
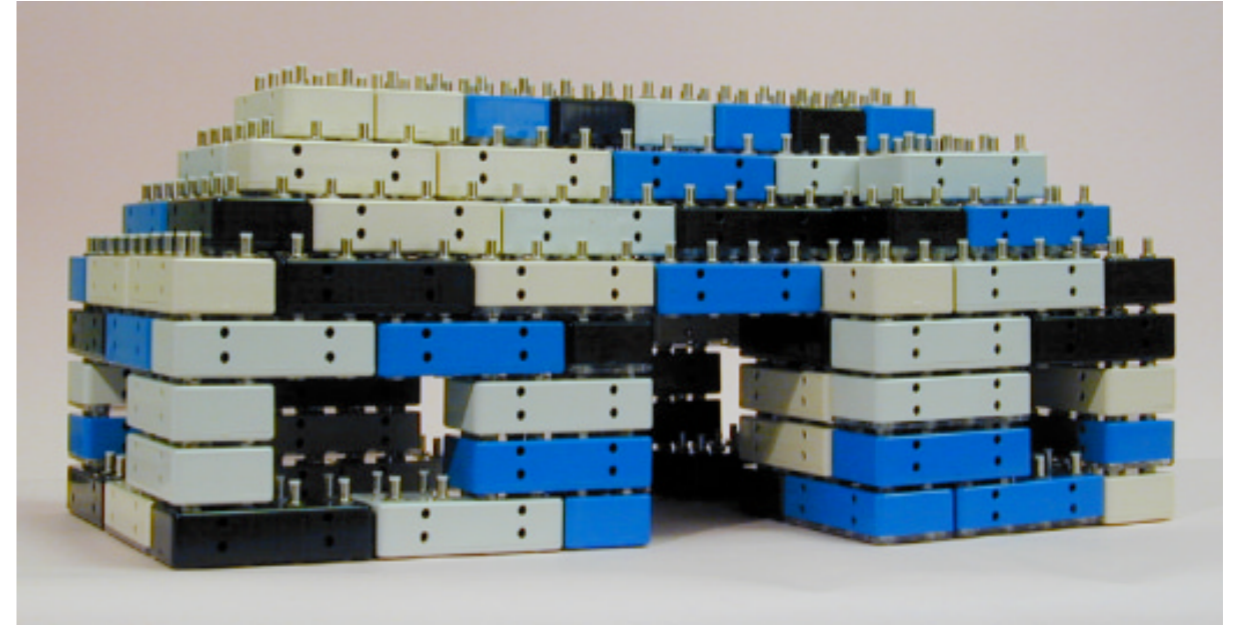
# Tangible User Interfaces

## Specialized TUIs

# 3D modeling with LEGO

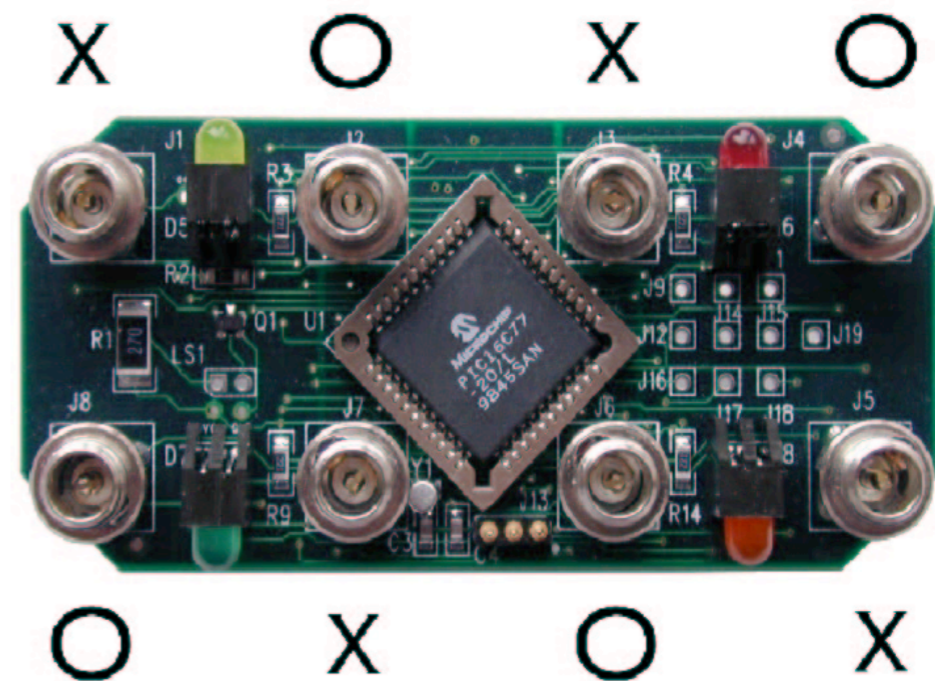
(Anderson et al., SIGGRAPH 00)

- LEGO blocks with connectors and CPU
  - Keep track of their spatial configuration
  - Describe a voxel („volume pixel“) model
- Reconstruction in the host computer
- Interpretation acc. to prototypes



# 3D modeling with LEGO

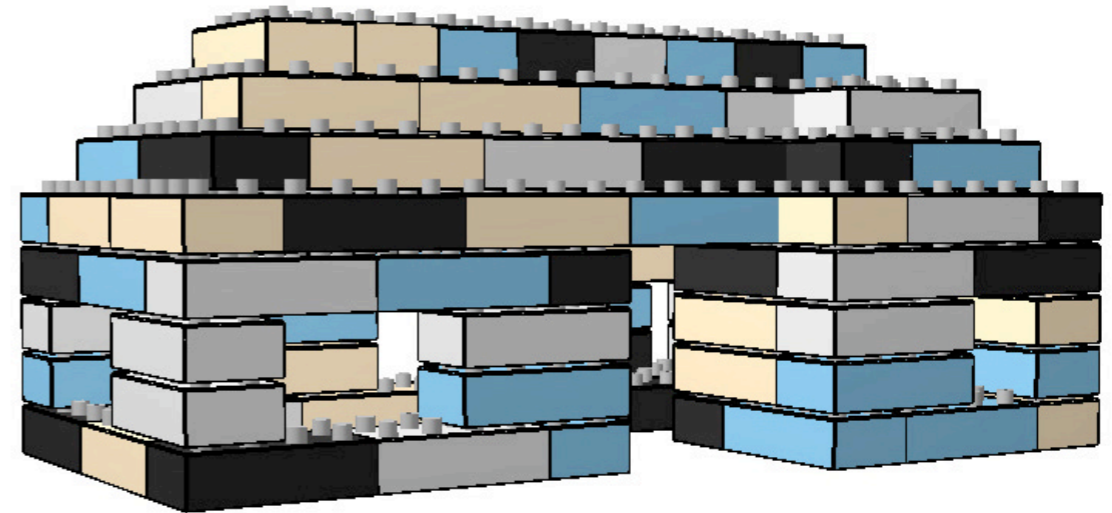
- Each block has 8 plugs on top and 8 jacks on the bottom
  - Inner contact: communication
  - Outer contact: power
  - Use alternating layout and rectifier to power circuit
- When a new block is added, it triggers recognition process



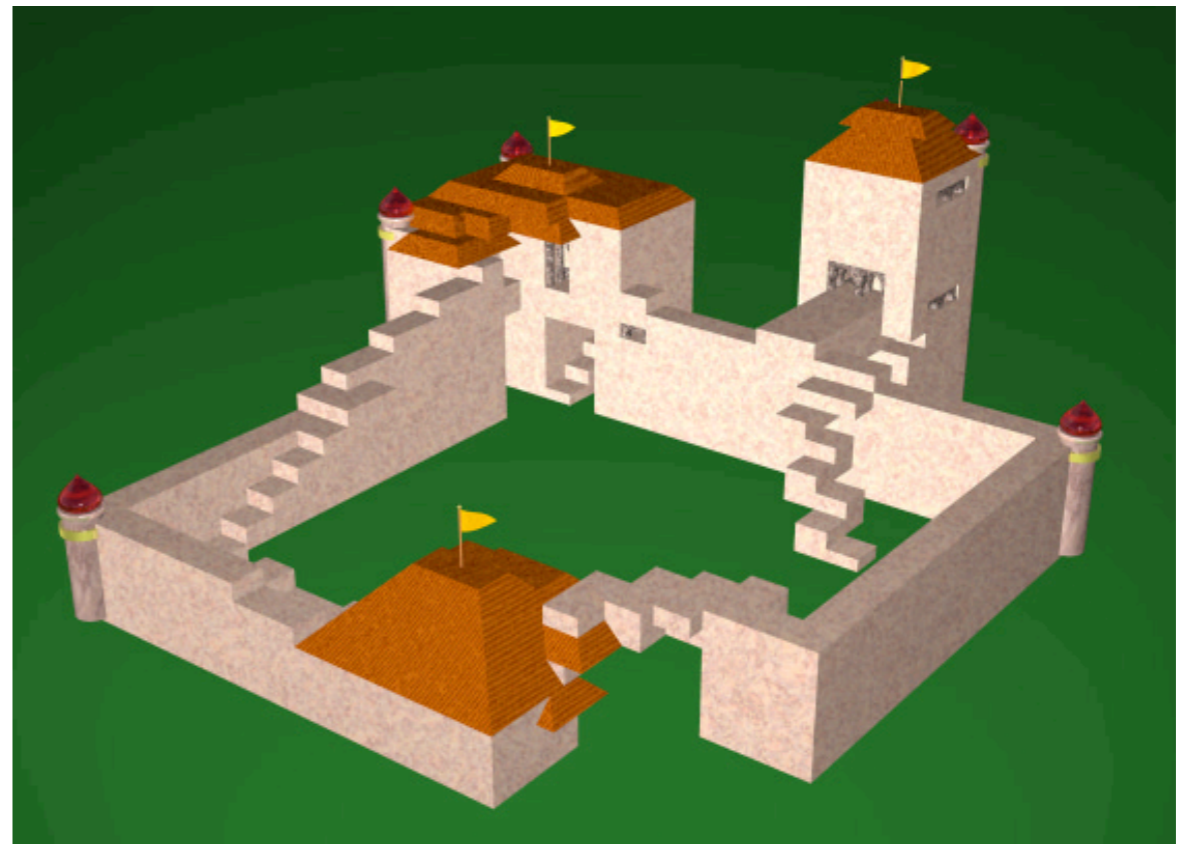
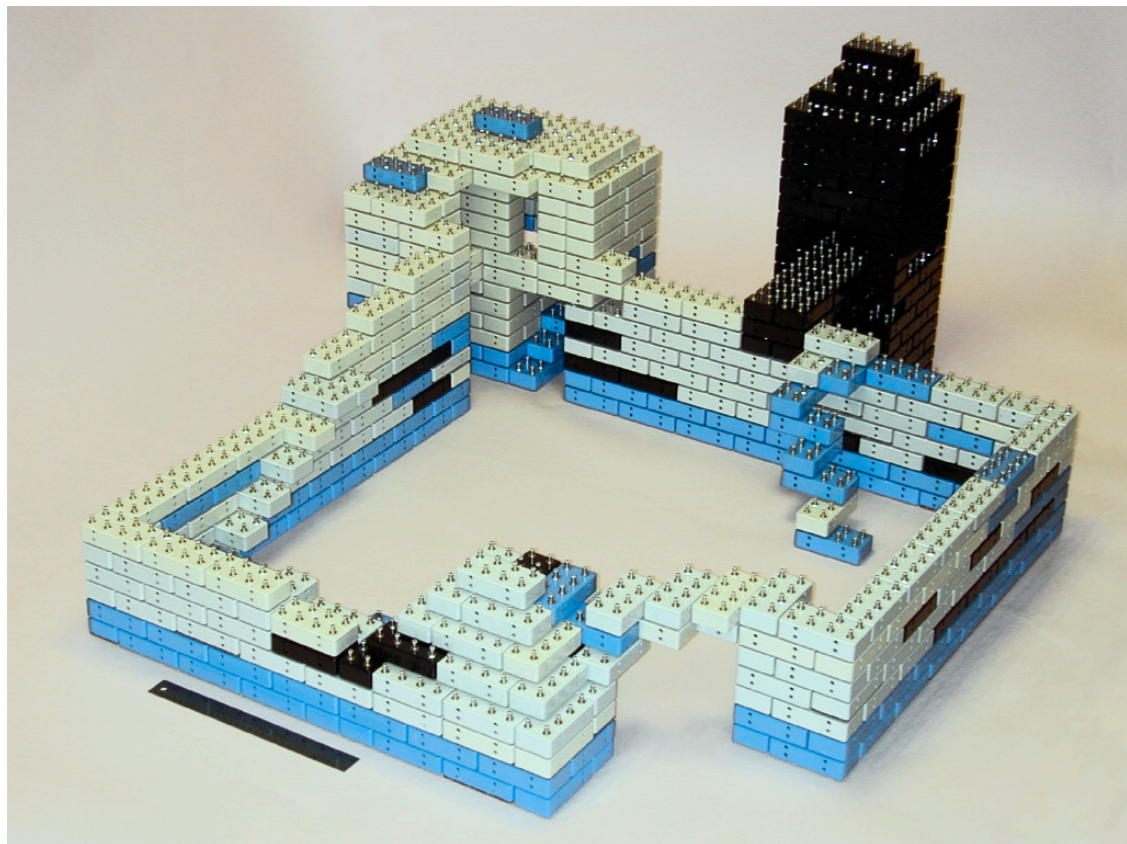
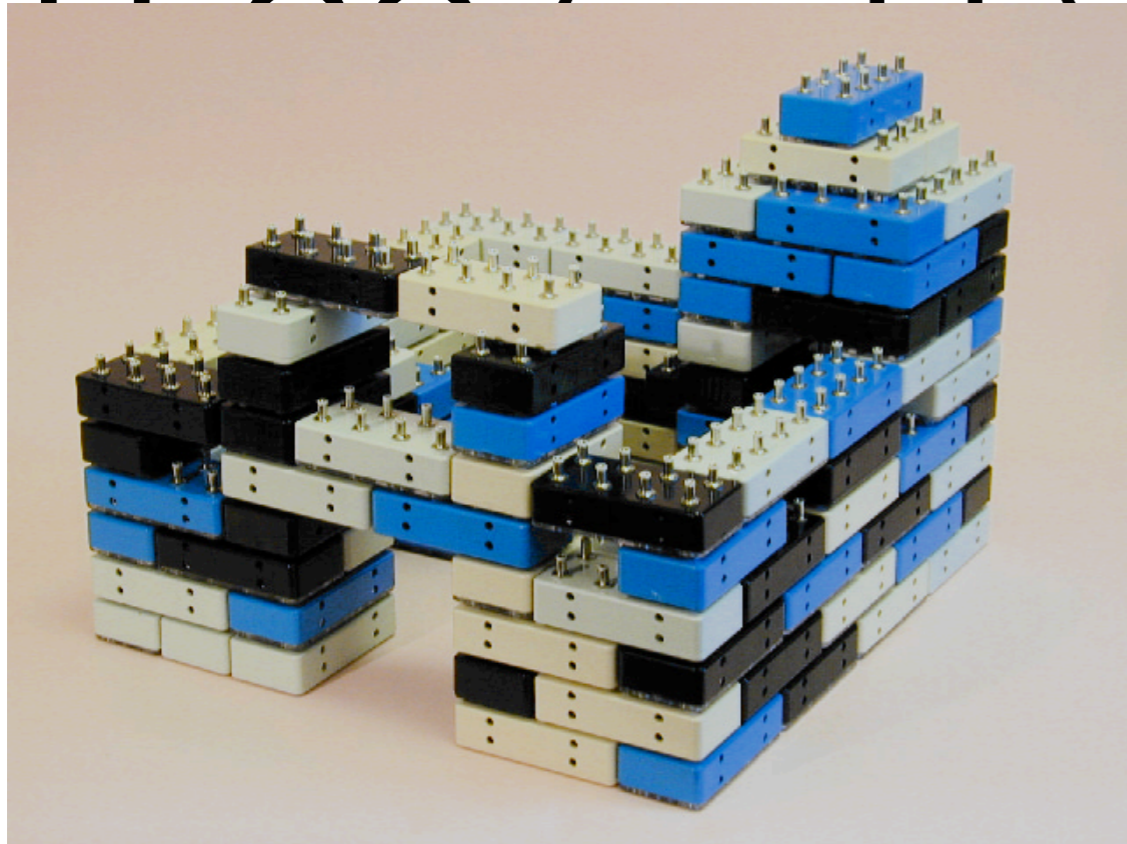


# 3D modeling with LEGO

- Interpretation of structure:
  - Transform structure into a set of logical propositions
  - Define rules what is a wall, roof, window...
  - Determine from structure and rules, what block has which function
  - Construct 3D model accordingly



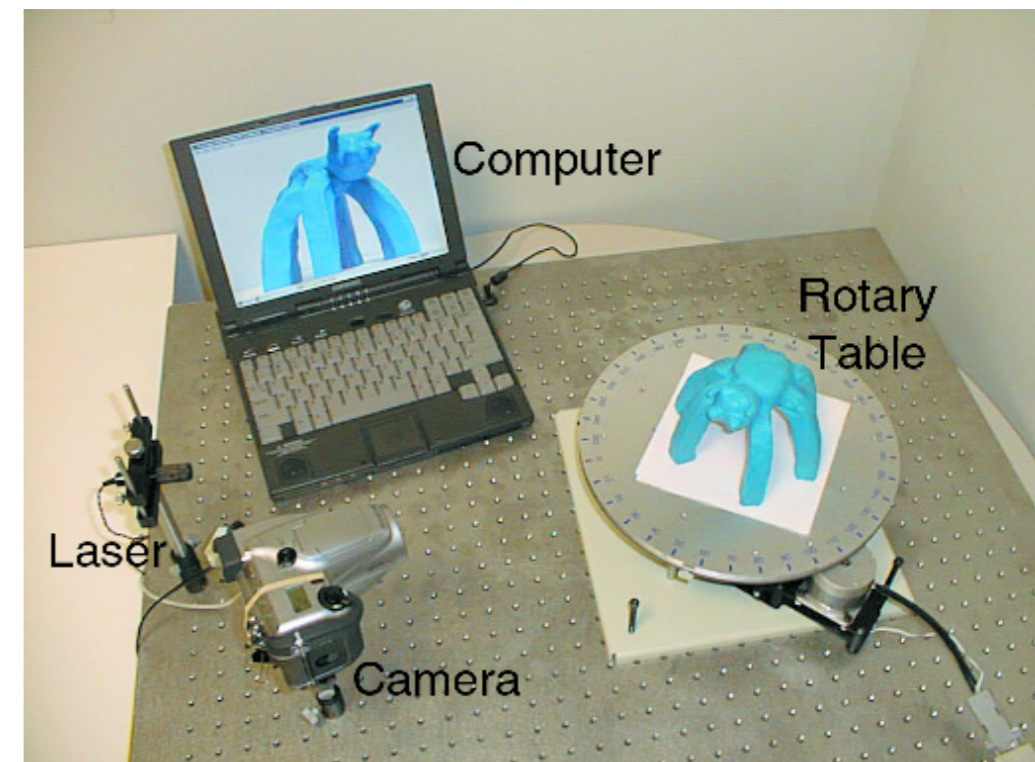






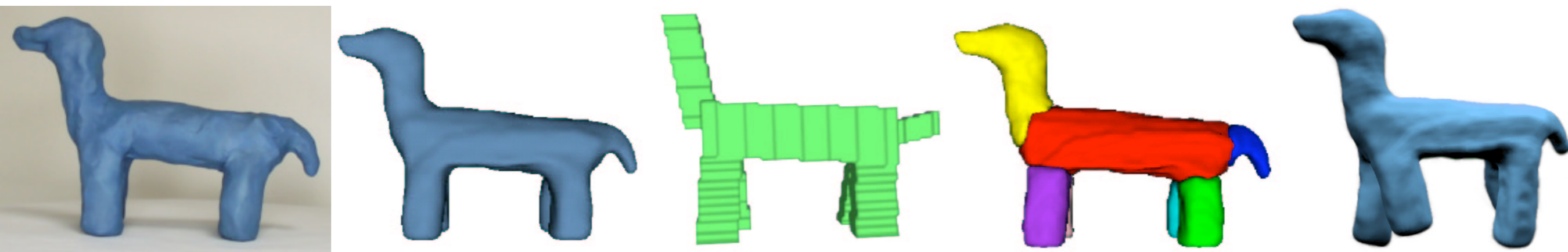
# 3D modeling with clay

- Model an object in clay
- Scan in its 3D shape
  - Laser striper
  - Camera recording silhouettes
- Try to recognize the structure by matching it to templates
- Interpret the structure according to template and animate it



# 3D modeling with clay

- Direction is known, size is normalized
- Compare for each voxel, whether it is filled in the template and the scan → find best match
- Templates have meaningful segments
- Cut scan into the same segments
- Use skeleton animation with the scan

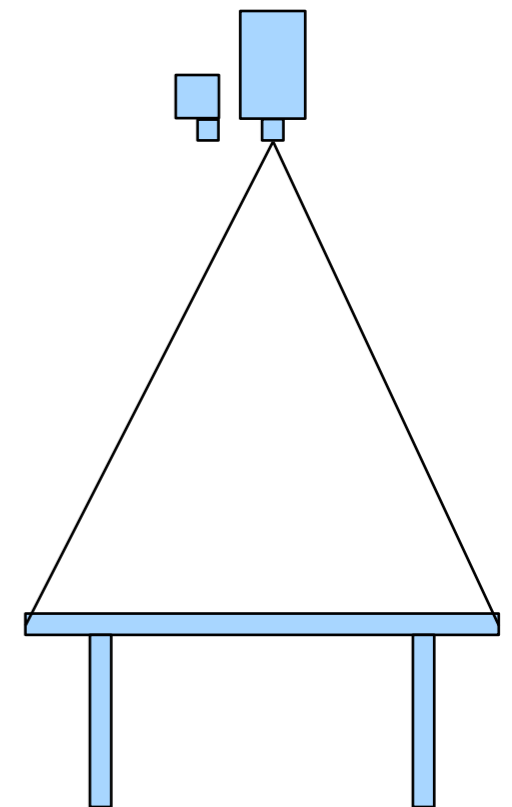
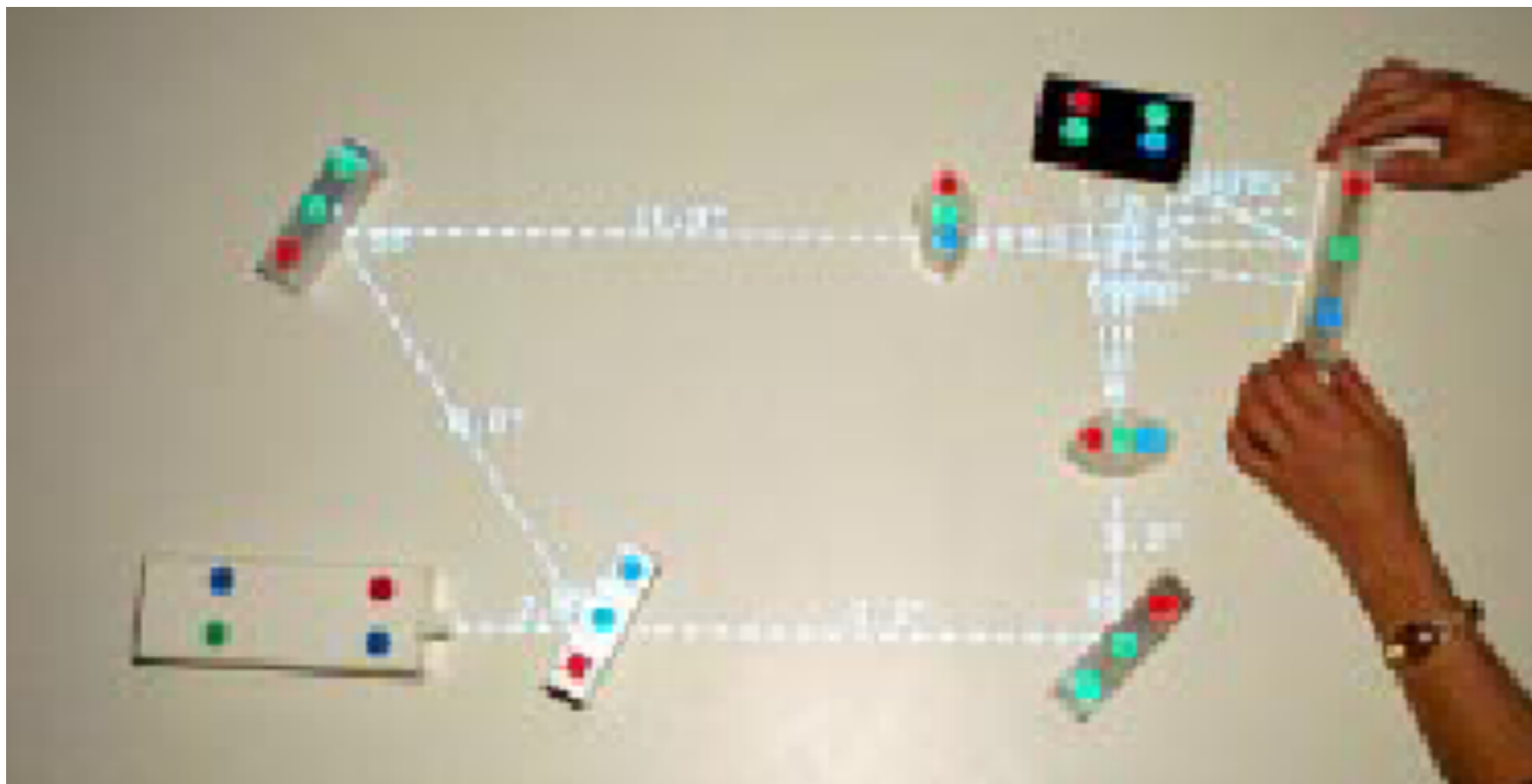




# Luminous room: Illuminating Light

[\(John Underkoffler and Hiroshi Ishii, CHI 98\)](#)

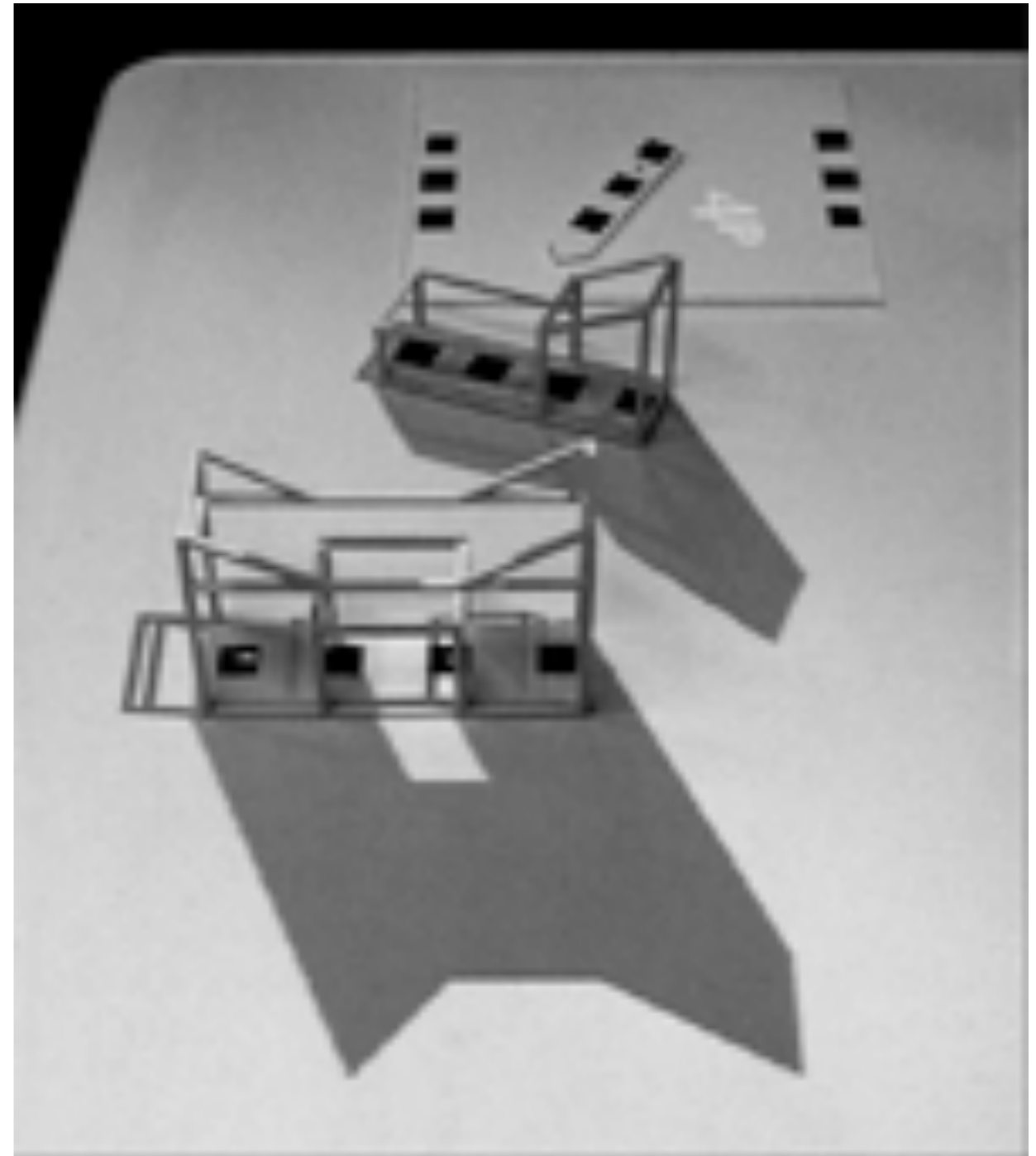
- Simulation of optical/holographic setups
- Phys. objects represent optical elements
- Top projection of resulting laser beam



# Luminous room: Urban Planning (URP)

(John Underkoffler and Hiroshi Ishii, CHI 99)

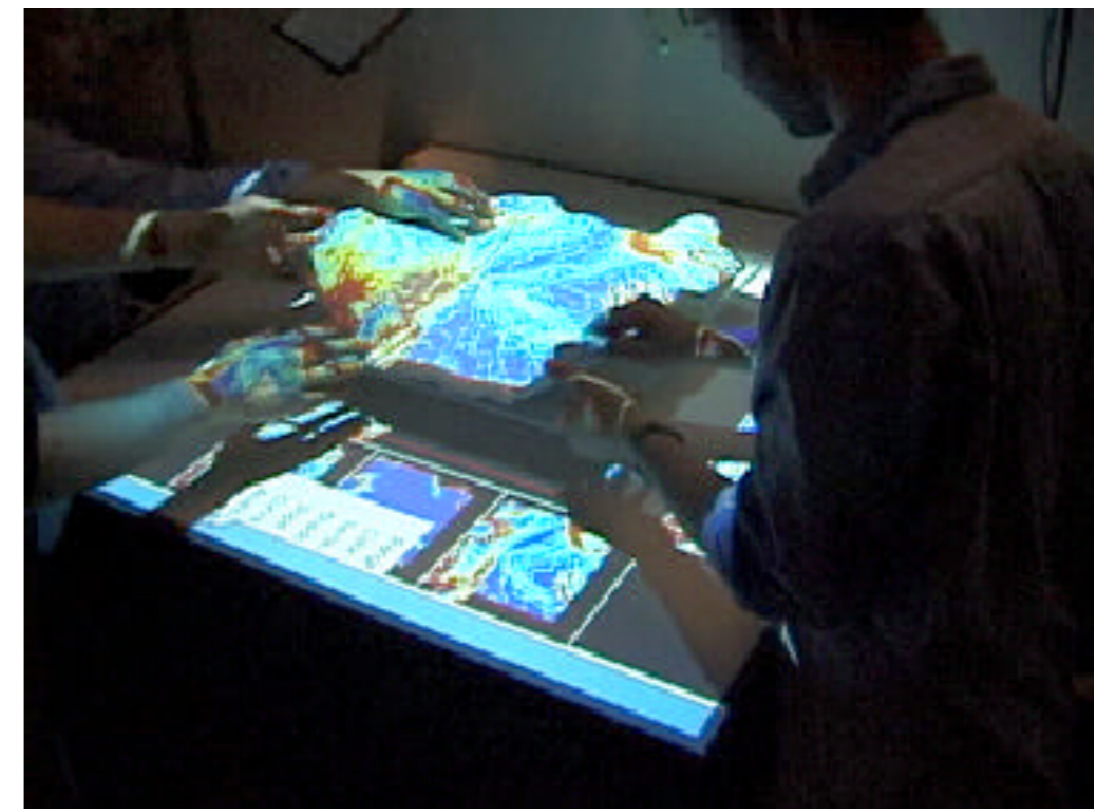
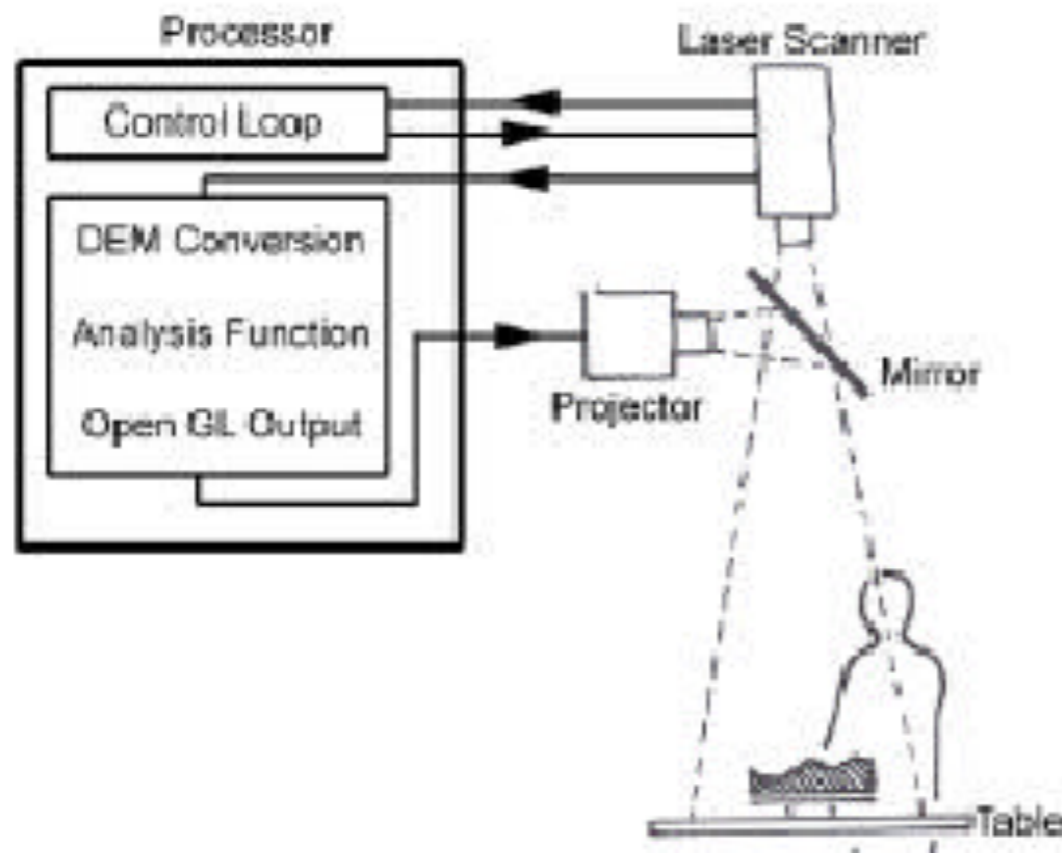
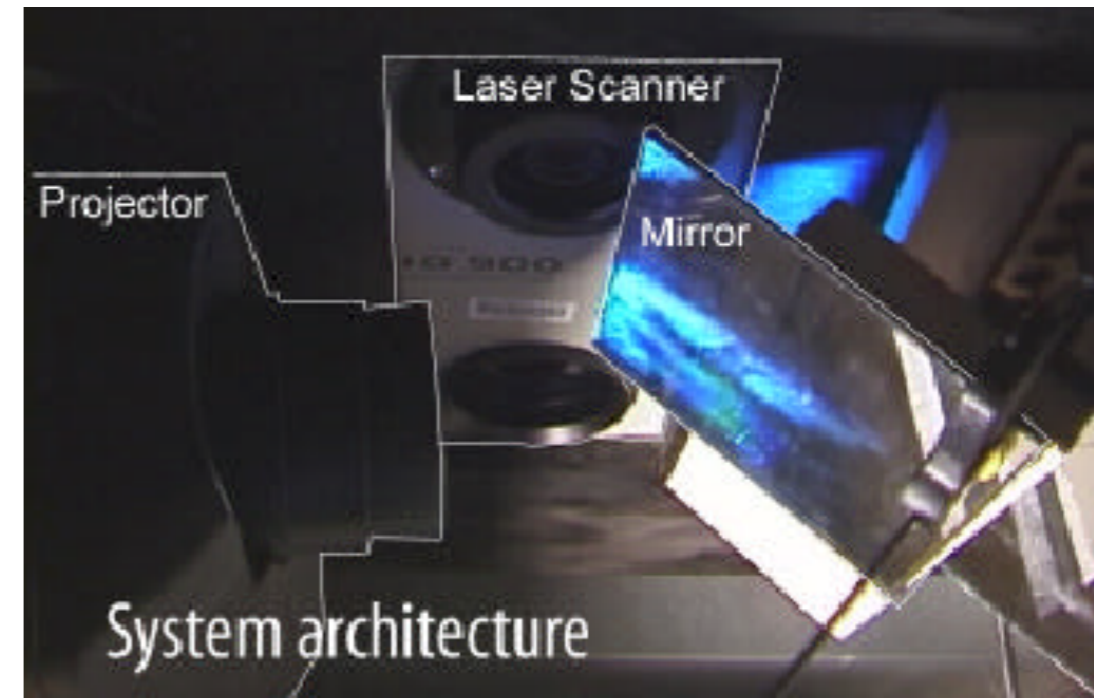
- Move physical models of houses on a desk surface
- Simulate in the computer:
  - Shadows
  - Window reflections
  - Air flow and wind



# Illuminating Clay

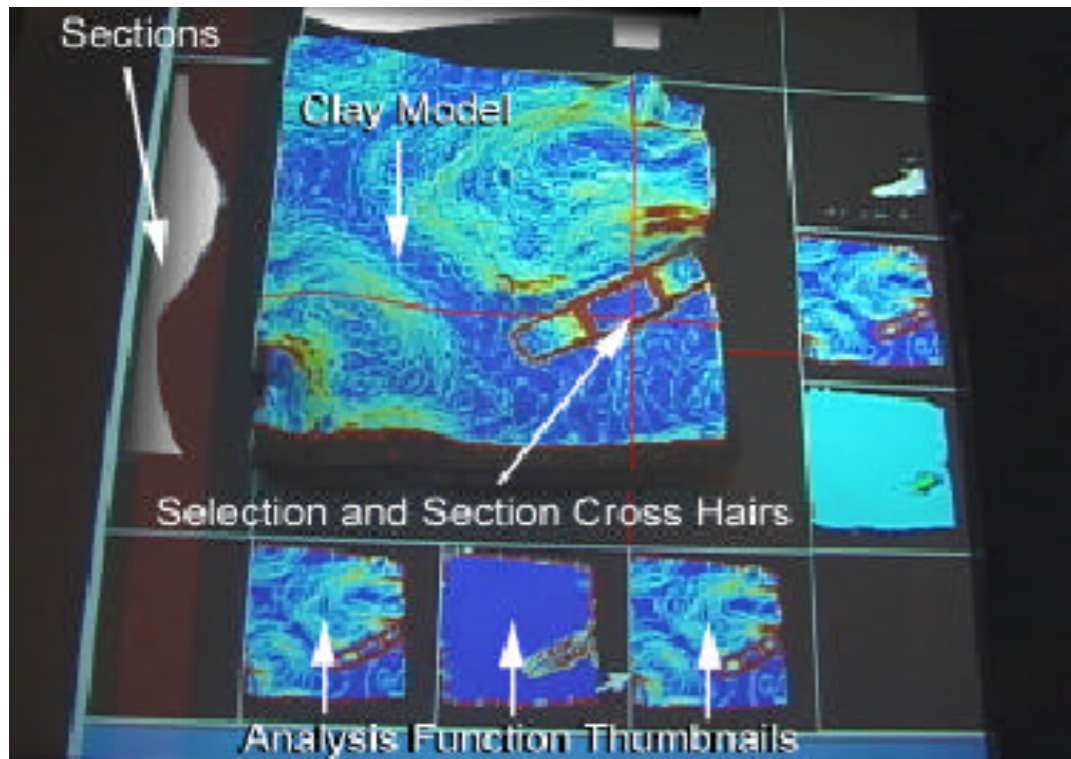
(Piper, Ratti, Ishii, Chi 02)

- Clay model on desk surface
- Top projection = output
- 3D laser scanner = input
- Used for landscape design

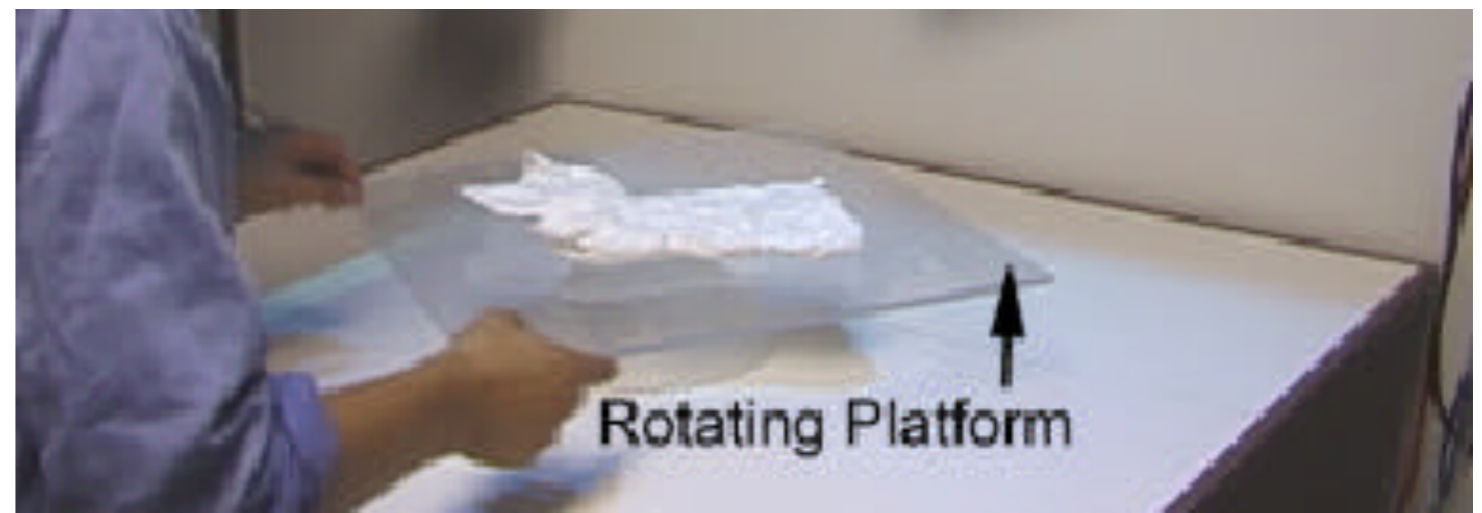
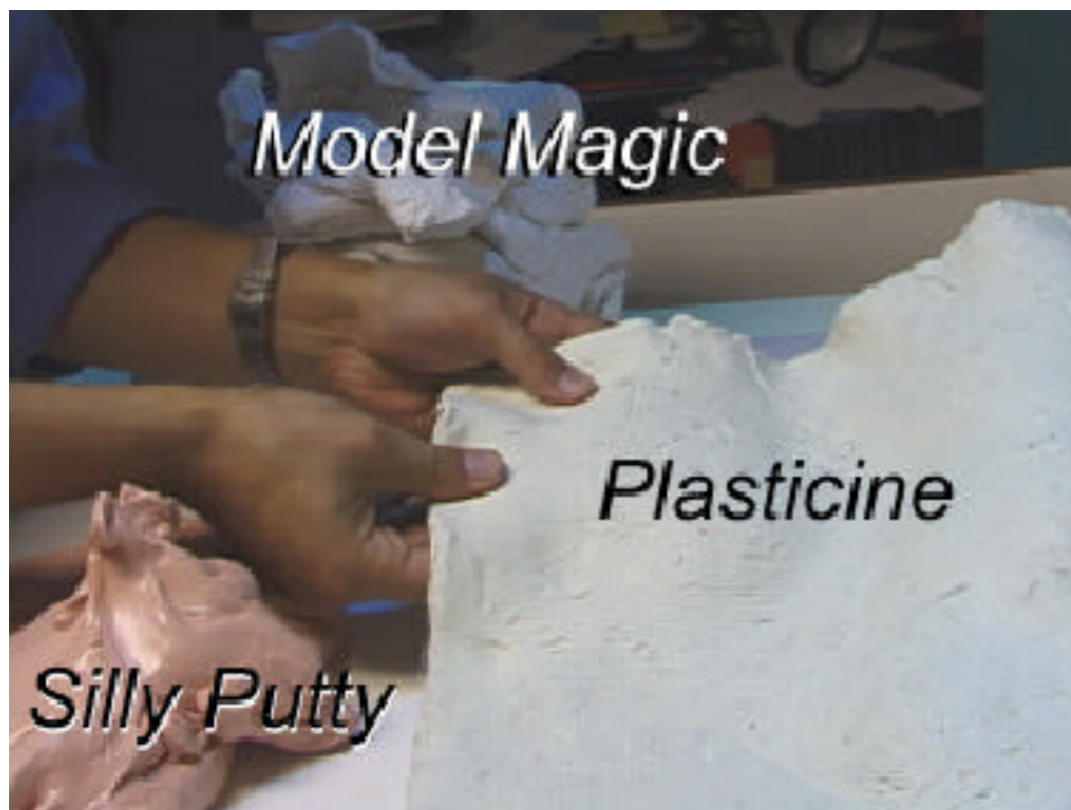




# Illuminating Clay UI elements



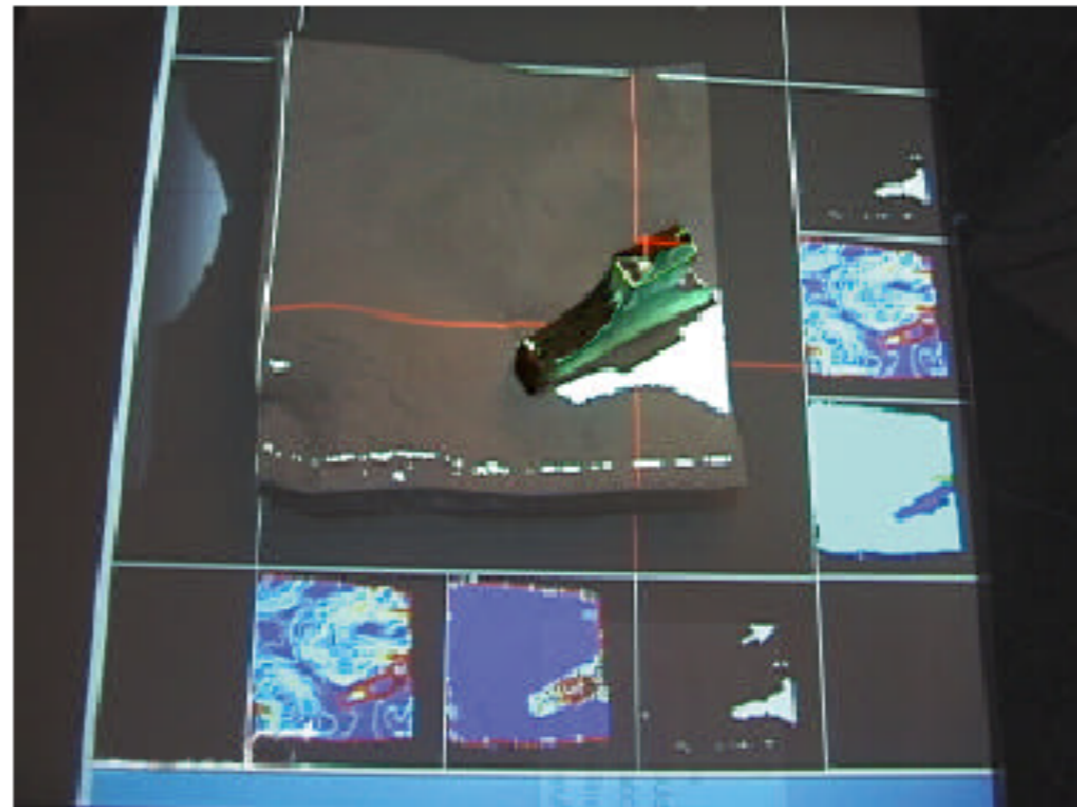
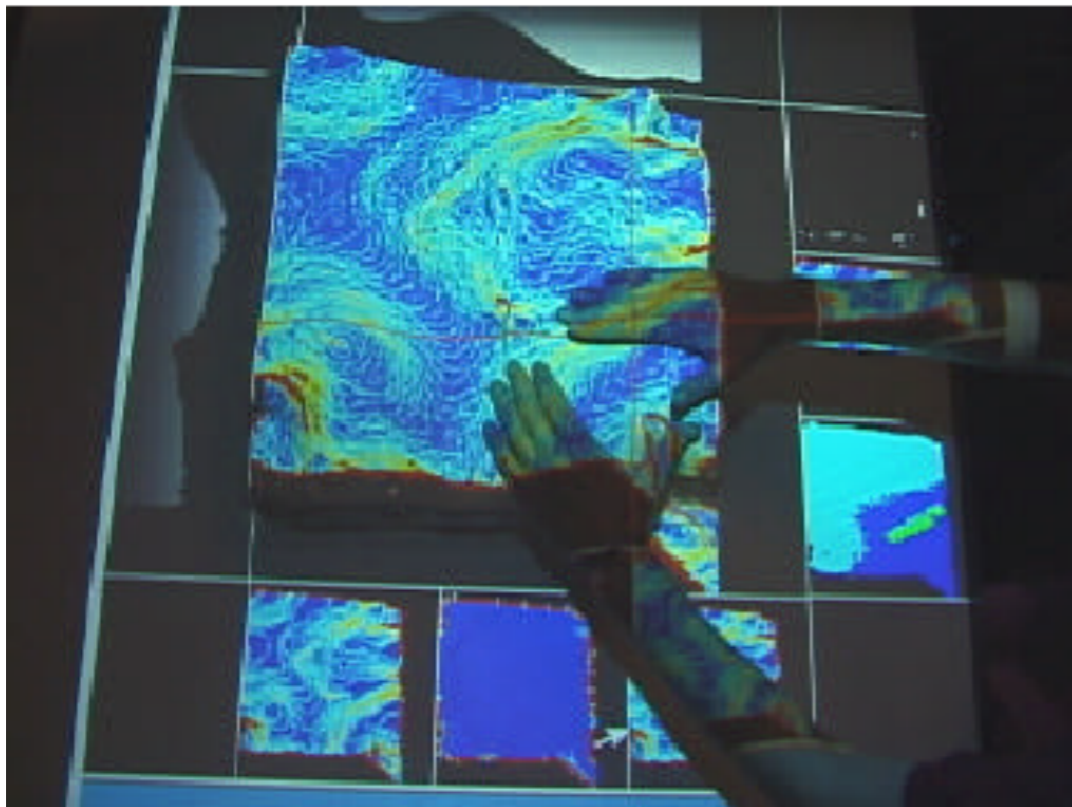
- Deformable clay model
- UI elements for section and analysis functions
- Interaction with terrain





# Illuminating Clay applications

- Slope variation with color feedback
- Solar radiation, shadows



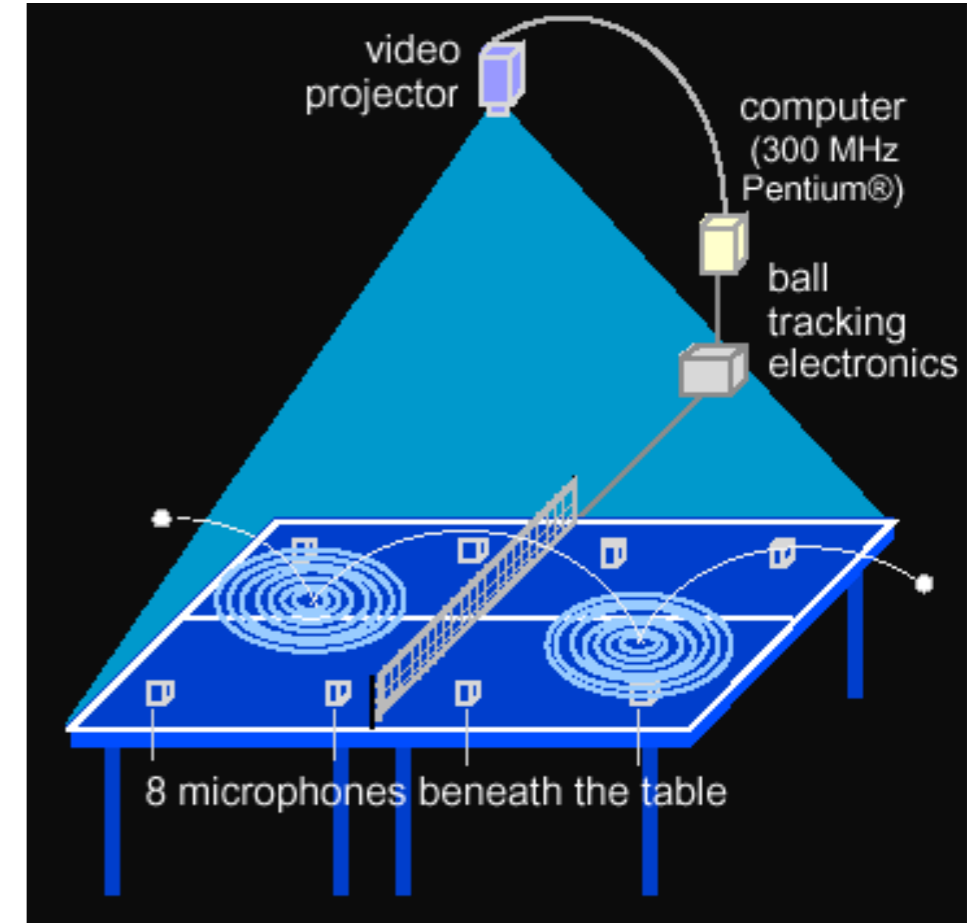
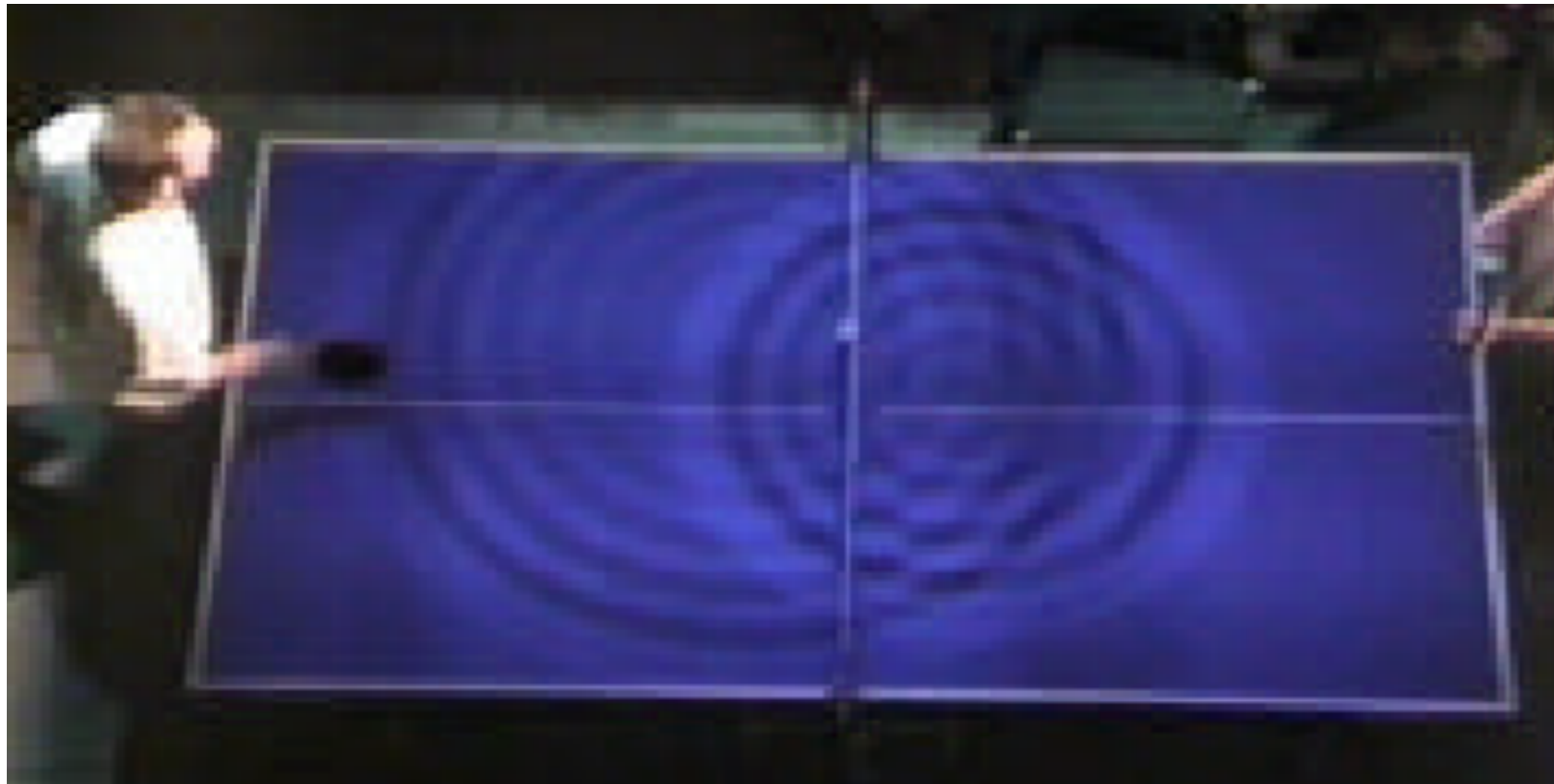
# Tangible User Interfaces

TUIs in everyday objects

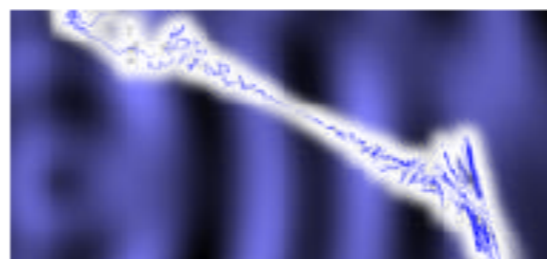
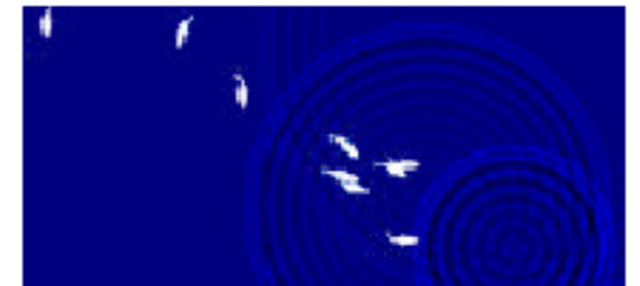
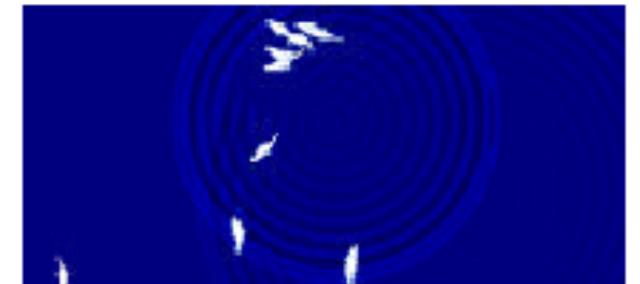
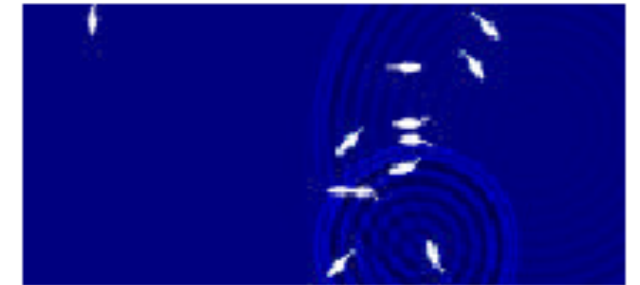
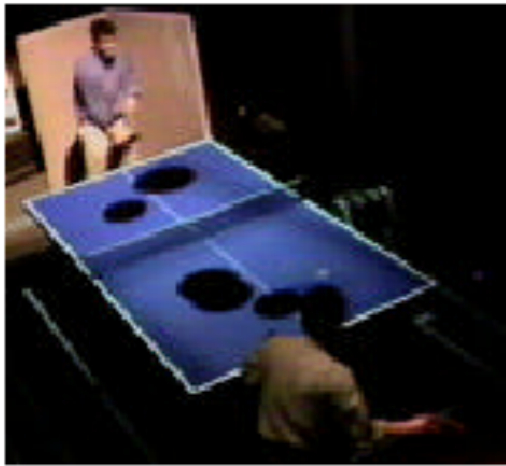
# PingPongPlus

(Ishii et al. SIGGRAPH 98)

- Physical PingPong
- Virtually augmented
- Additional game functionality



# PingPongPlus variations





# MusicBottles

(Ishii, Mazalek, Lee, CHI 01)



- Bottles contain music (classical, jazz, techno)
- When placed on the desk, light appears around them
- When opened, music can be heard
- Metaphor: bottles contain something, can be released when bottle is opened



# Marble Answering Machine

(concept study by Gary Bishop, RCA)

- Design study and some prototypes
- Each message represented by a marble
- Placing the marble on tray plays back the message
- Placing the marble on the phone calls back



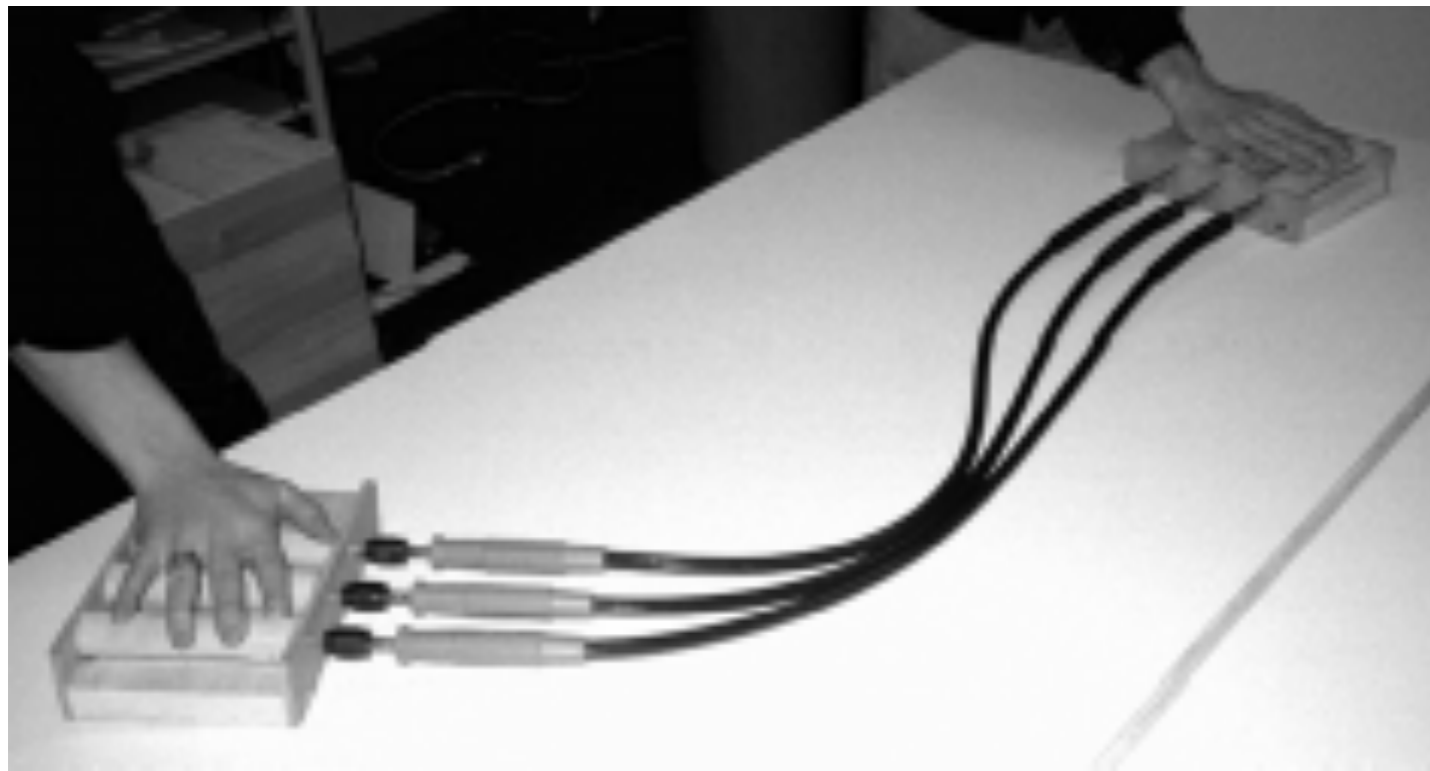
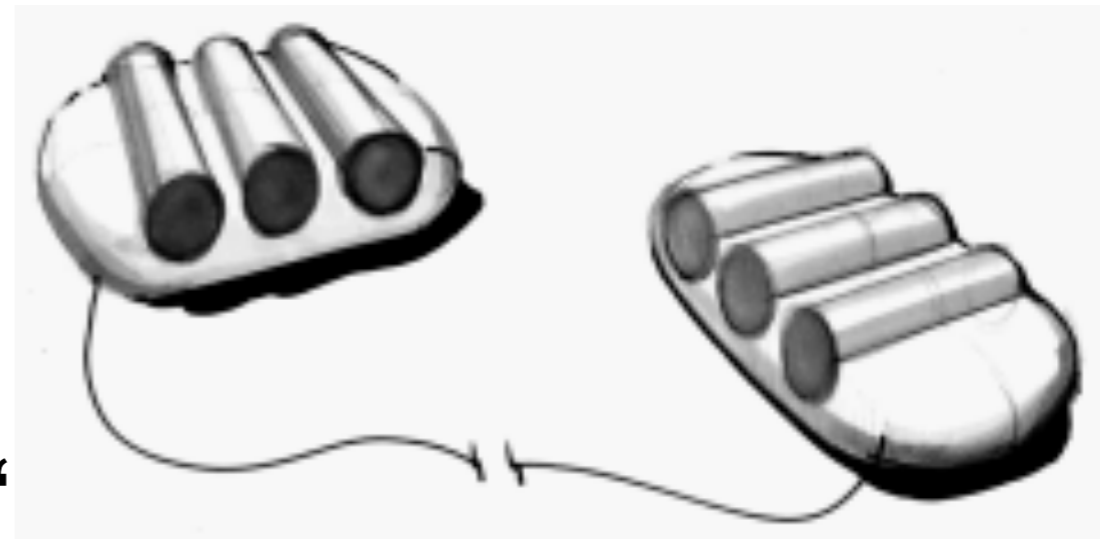
# Tangible User Interfaces

## Communicative TUIs

# InTouch

(Brave, Ishii, Dahley, CSCW 98)

- UI for remote „awareness“
- Enhance the feeling of physical presence

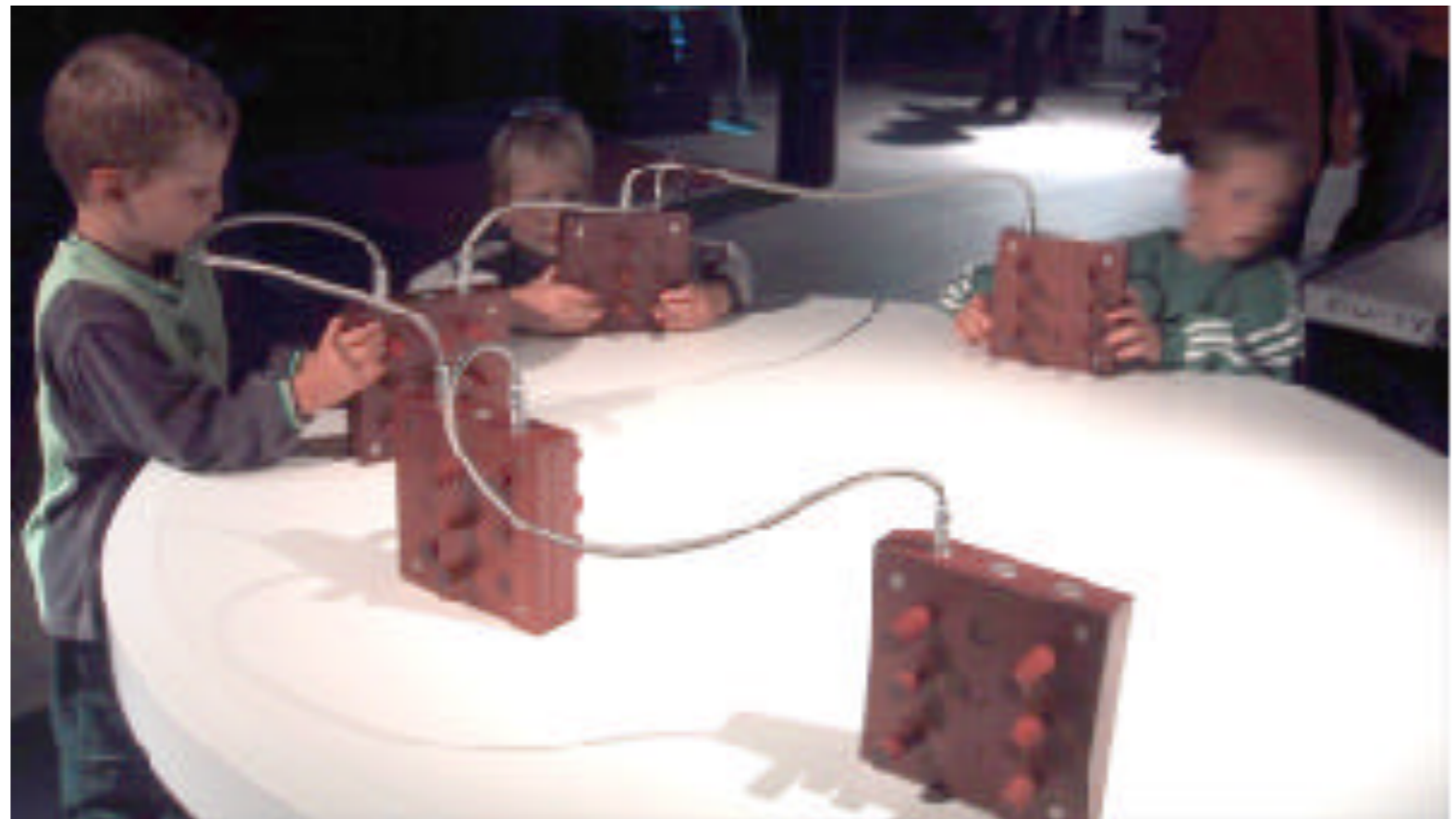




# PegBlocks

(Piper, Ishii, CHI 02)

- Networked blocks with turn- and pushable pegs
- Used to teach kindergarten children about basic physical concepts (and to play, of course ;-)



# Ambient User Interfaces

Integrated in everyday  
environment,  
Peripheral perception

# Waterlamp

(Dahley, Wisneski, Ishii, CHI 98)



- Lamp shining from below
- Water surface by 3 actuators
- Changing information creates ripples on water surface
- Result: patterns projected on the ceiling



# Pinwheels

(Dahley, Wisneski, Ishii, CHI 98)



- Actual pinwheels, mounted on small DC electrical motors
- Rotation speed changes according to information flows
- Metaphor: flow of air ↔ flow of information

# The window as the interface

(Rodenstein, 99)

- Projection on „privacy film“ (by 3M)
- Can be made transparent or opaque by applying electricity



Figure 2: It will freeze tonight, better wear gloves.



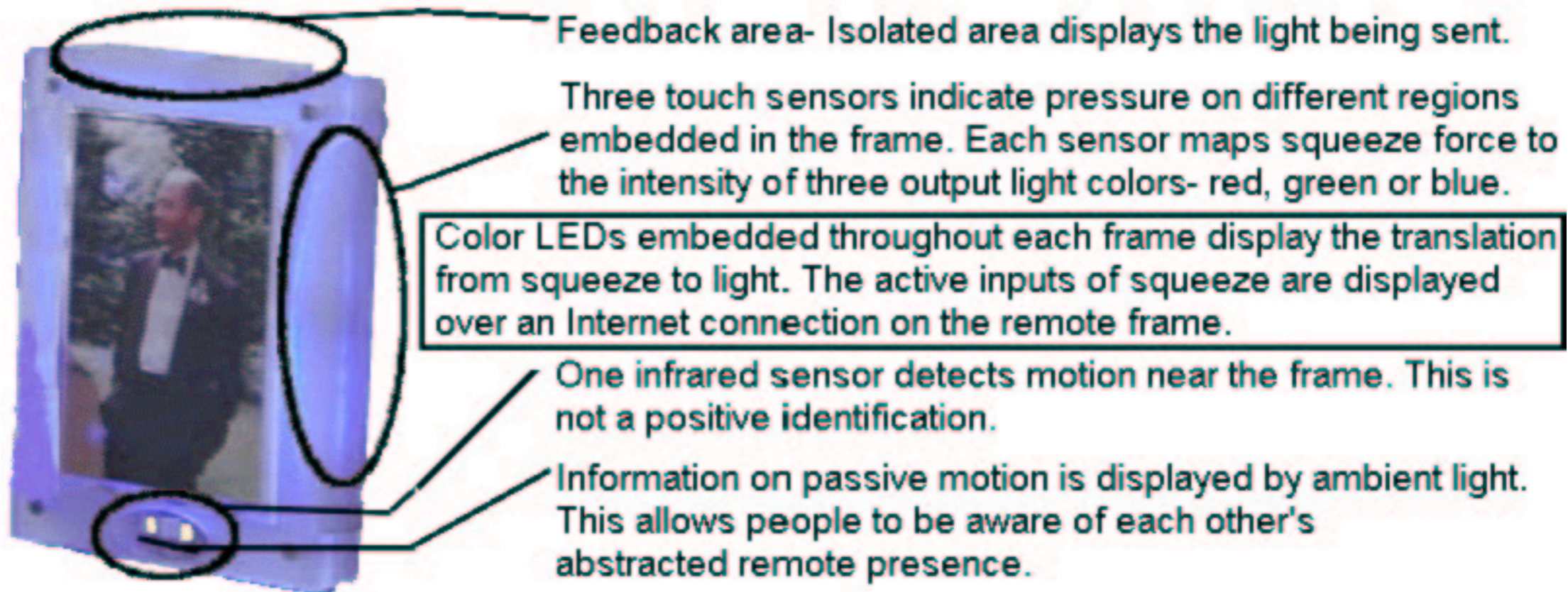
Figure 1. It will get stormy in the next few hours.



# LumiTouch

(Chang et al. CHI 01)

- Connected picture frames
  - show when other frame is squeezed
  - Create a feeling of mutual awareness

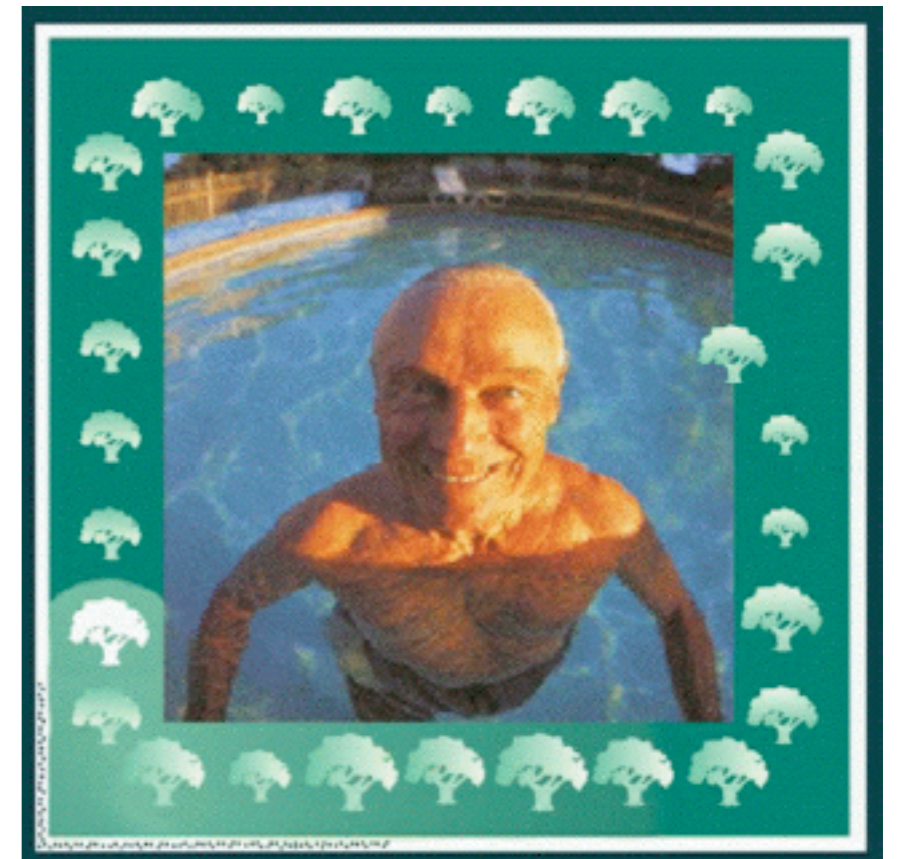




# Digital Family Portrait

(Mynatt et al. CHI 01)

- In the “Aware home”
- Lets people “keep an eye” on others
- Balance betw. privacy and contact
  
- Icons around the frame indicate health, activity or relationships
- 28 icons on 4 sides = 4 weeks
- Position and size carry a meaning





# Major interaction models

- **strictly tool-based --> appliances**
  - Human is the cause of all action
  - Tools just facilitate these actions
- **automation, assisted living**
  - Things happen magically by themselves
  - Controlled by machine intelligence in the background
- **proactivity, intelligent agents**
  - Environment takes the initiative
  - Manifestation through a conversational agent

# Appliances (from wikipedia)

- Appliance: usually referring to a device with a narrow function
- A certain class of computer products, where the device has a specific function, and limited ability to configure.
- Some consider the PDA to be a form of appliance, since most consumers do not make use of them as general purpose computing platforms.



# Information appliances

[\[E. Bergmann, 2000\]](#)

- Information appliance: An appliance specializing in information: knowledge, facts, graphics, images, video, or sound. An information appliance is designed to perform a specific activity, such as music, photography, or writing.
- A distinguishing feature of information appliances is the ability to share information among themselves



# Smart Homes

(from wikipedia)



- The intelligent home is a technological achievement aimed at connecting modern communication technologies and making them available for everyday household tasks. [...]
- Intelligent home systems guide the user to perform any operation, to control lighting, heating, air conditioning, or to arm or disarm the security system, and to record or to listen to messages.
- Other themes envisioned in intelligent home systems are automation, connectivity, wireless networking, entertainment, energy and water conservation, and information access.



# Assisted living (from wikipedia)

- Assisted Living [...] usually refers to a non-medical facility that is used by people who are not able to live on their own, [...]
- This highlights a very important and realistic aspect of this concept when applied to technology:
  - Support for disabled people
  - Support for elderly people

# Instrumented Bedroom

- Support for disabled people
  - Robot person lift
  - Robot wheelchair
  - Robot bed
  - Fridge/oven combi
  - Sensing mattress
- Interface:
  - Control via voice input
  - Feedback via talking head („yes, master..“)
  - Gesture input (e.g., for TV for spastic patients)

<http://hwrs.kaist.ac.kr/>



# Instrumented Bedroom (2)



- Patient can move between bed and wheelchair
  - Wheelchair will come automatically
  - Lift will act on commands
  - Bed will adapt shape on command
  - Fridge will heat up meal
- Sensing mattress can tell whether...
  - patient is in right position
  - patient has fallen off
- Safety + self-determined life
  - Nurse not constantly needed
  - Environment can call if there seems to be a problem
  - Sense of Mastery („yes, master..“)

<http://hwrs.kaist.ac.kr/>



# The Virtual Room Inhabitant (VRI)

[\[Kruppa et al. AI05\]](#)





# emotional agents: ideas4games

<http://www.dfki.de/It/iprojects/ideas4games.php>

