Einführung in die Erweiterte Realität
- 12. Intelligent Environments and Ubiquitous Computing -

Gudrun Klinker

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The Kids Room

A Perceptually-Based Interactive and Immersive Story Enviroment

MIT Media Lab

http://www-white.media.mit.edu/vismod/demos/kidsroom/

Overview

- **1. Idea and goals of the kidsroom**
- **2. Technical setup of the playspace**
- **3. The story**
- **4. Object tracking and movement detection**
- **5. Story-control techniques**

1. Idea and Goals of the Kidsroom

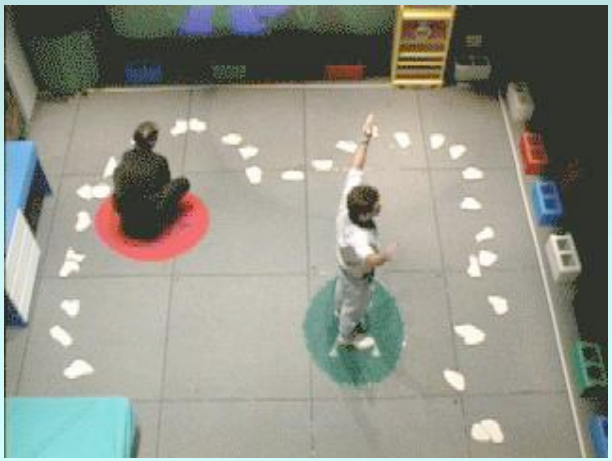
- **a) Test of techniques under tight time constraints (8 weeks total)**
- **b) General concept**
- **c) Goals**
  - **Actions take place in a real room**
  - **Visitors don’t wear any special gear.**
  - **Several people play together.**
  - **Computers can change the story.**
  - **Non-transparent story.**
  - **For kids!**

2. Technical Setup

- **Theatre lights and equipment**
- **2 video walls, 2 normal walls**
- **Directional sound (4 speakers)**
- **Microphone**
- **4 cameras (3 tracking, 1 spectator)**
- **3 SGI Indy R5000 workstadion**
- **2 Digital Equipment AlphaStations**
- **1 Macintosh (nur MIDI Software)**

The Playspace

- **4 small carpets in different colors**
- **movable bed,**
- **various pieces of furniture (fixed to the floor)**

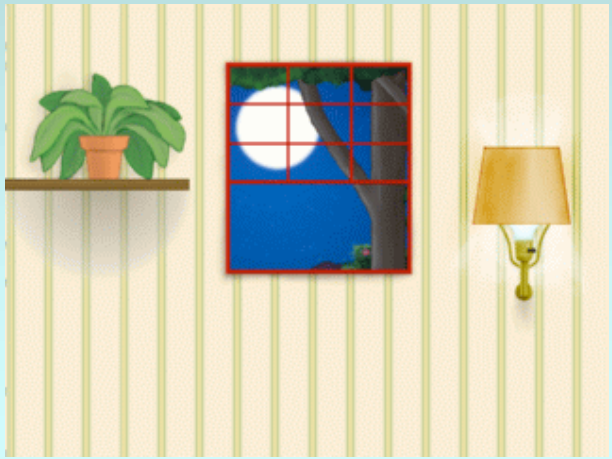




3. The Story

- **Bedroom world**
- **Forest world**
- **River world**
- **Monster world**

3.1 The Bedroom World

- **The kids enter individually through a small door**
- **They ask for a “magic word”**
- **Pieces of furniture answer**
- **A treasure hunt starts**
- **Once the word is found, the kids scream it**
- **The room changes appearance**



3.2 The Forest World

- **The kids have to follow a path to a river**
- **When they hear monsters, they have to hide behind the bed (representing a tree)**
- **After the monsters have disappeared, the kids continue their path to the river.**

3.3 The River World

- **The bed turns into a boat**
- **It has to be moved into the middle of the room**
- **All kids must be in the boat to cross the river**
- **They have to manouevre around rocks**
- **If a kid leaves the board, the action is interrupted**
- **Eventually, they cross the river, the bed has to pushed back into its original position**

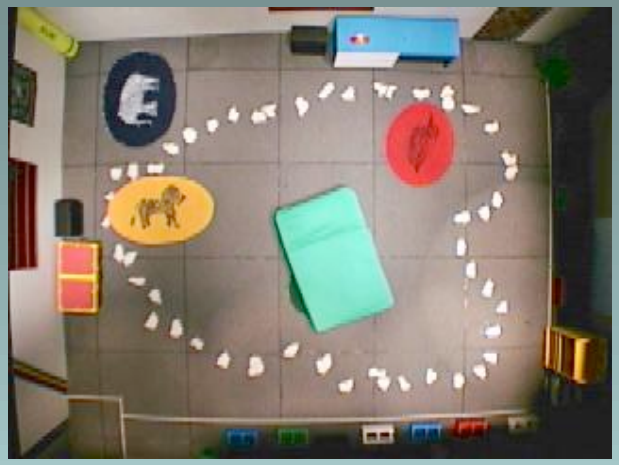
3.4 The Monster World

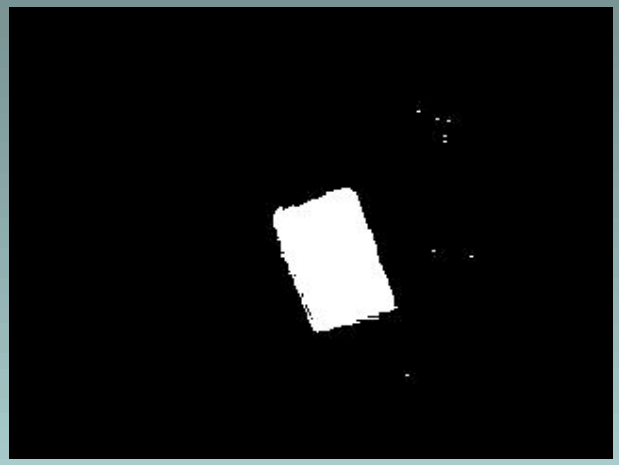
- **The kids have to gain the monsters' attention by screaming**
- **The kids are asked to dance with the monsters**
- **They have to be on the colored carpets**
- **The monsters teach them several figures: Y, crouch, rotation**
- **Kids can teach the monsters a new dance sequence**
- **All kids have to stay on their carpets**

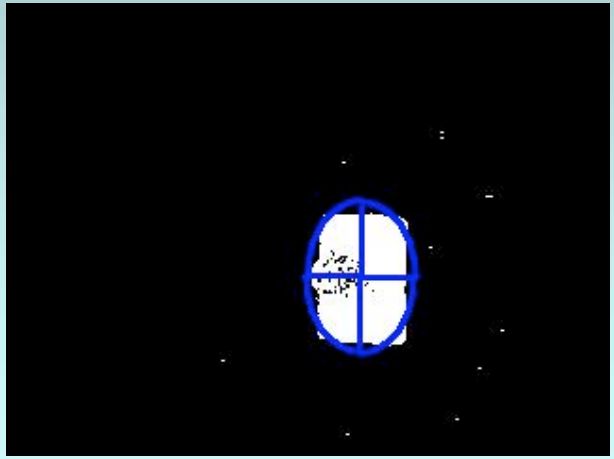
4. Object Tracking and Movement Detection

4.1 Object Tracking

- **The system must know**
  - **How many visitors?**
  - **Where are they?**
  - **Where is the bed?**
- **Upon entering the room:**
  - **Visitor detection**
  - **Background removal**
  - **Blob modelling**
- **While in the boat:**
  - **Blob analysis (bed) to check that nobody is overboard**





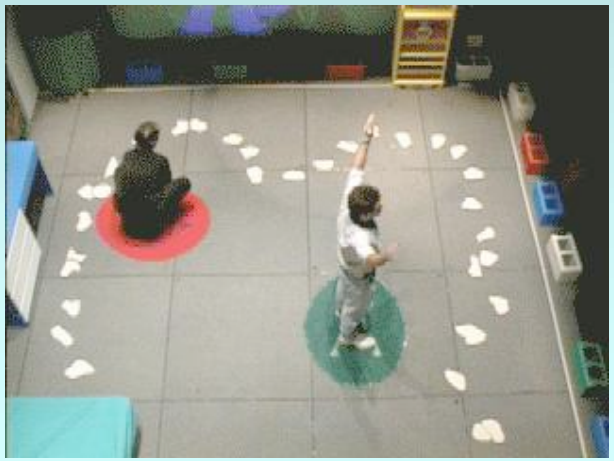


4.1 Object Detection: Problems

- **System confuses different kids (nobody is called by name)**
- **System looses very small kids**
- **System does not work under changing light conditions**

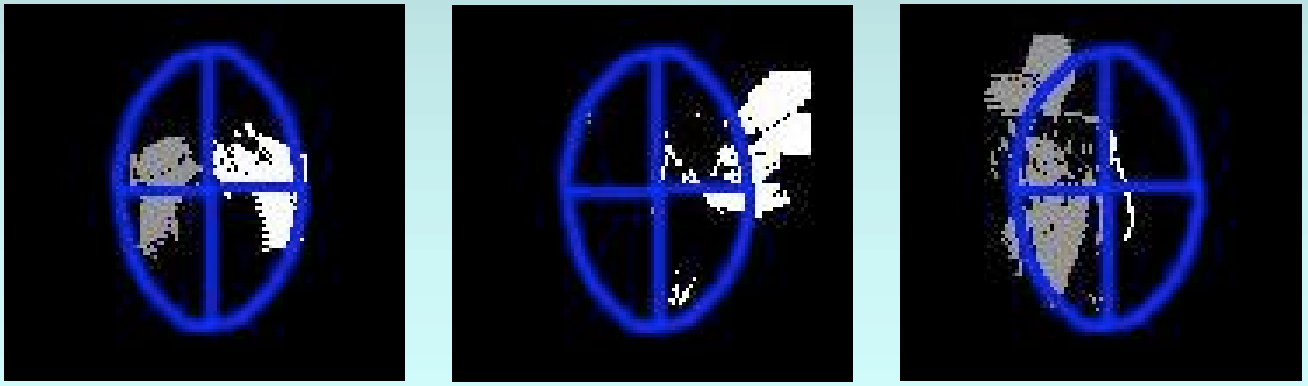
4.2 Movement Detection

- **Recognition of kids' motions in the monster world**
- **Specially installed cameras (2 and 3)**
  - **focussing on the colored carpets**
  - **background subtraction**
  - **comparison with reference images (from test phase)**
  - **most probable motion is selected**



4.2 Movement Detection

- **Recognition of rowing actions in the river world**
- **Top-view camera**
  - **accumulated motion**
  - **clustering**
  - **classification**



4.2 Motion Detection: Problems

- **No overlap between several objects/visitors**
  - **All furniture bolted to the floor**
  - **Well-planned arrangement of carpets, cameras and displays**
- **No illumination changes**
  - **During motion detection**
- **During the rowing action**
  - **Use of top-view camera**
  - **Boat is in the middle of the room**
  - **All kids must be in the boat**
  - **“Easy” change detection**
- **Maximally 4 kids!**

Some Computer Science Issues
In
Ubiquitous Computing

Mark Weiser

Ongoing work at Xerox Parc since 1988

(Comm. ACM Vol. 36, No. 7, 1993, pp 75-84)

Definition

Hundreds of computers available throughout the physical environment:

- Close to one another
- Wirelessly interconnected
- Invisible !!!

Affinity to concepts of Virtual Reality

Motivating Background

Antropological studies of „work life“:

- People primarily work in a world of situations.
- Computers are isolated from overall situation (get special attention).
- TOO much attention to the computer !!! („intimate computer“, „personal assistant“).

Issues in Making Computers Invisible

Challenge: new kind of relationship: people <=> computers

- Physical properties of devices (size, weight)
- Keyboard, mouse, ...
- Position of screens
- NOT: „just an“ interface problem
- NOT: „just a“ multi-media problem

Approach

- Construct working infrastructure prototypes
- Debug system viability in everyday use
- Guinea pigs = researchers + colleagues

Every person should be able to have:

- Several „*Boards*“ (wall-size)
- Tens of „*Pads*“ (A4 paper-size)
- Hundreds of „*Tabs*“ (Post-it note-size)

Hardware: Liveboard

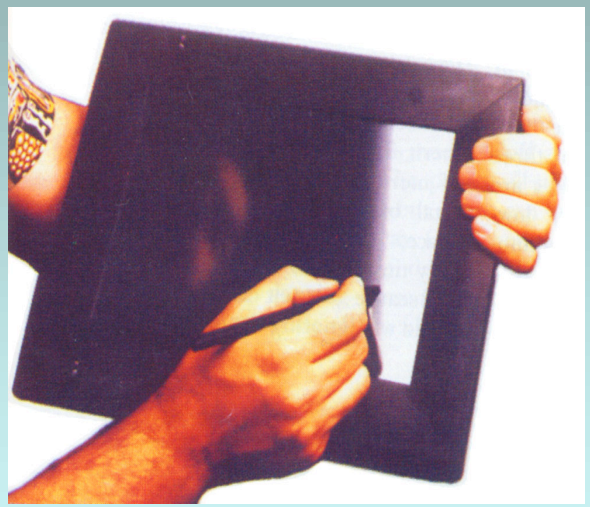
- Sun Sbus
- X-windows-compatible
- Touch-sensitive surface

Hardware: ParcTab

- Touch-sensitive screen
- 3 buttons at finger positions
- Can sense its position in a building
- IR interface
- Hundreds
- Main problem: physical size, power consumption (battery life >> one week!)

HW: ScratchPad, XPad, MPad

- Initially Sun S-Bus, later untethered
- X-windows-compatible
- Ease of construction
- Flexible SW and HW expansion



CS Issues

- Hardware Components
- Wireless Communications
- Pens
- Network Protocols
- Interaction
- Applications
- Privacy of Location
- Computational Methods

CS Issues:
HW Components

- Low-power computing and communication rather than increased performance

CS Issues:
Wireless Computing

- Network with hundreds of devices per person (900 MHz in 1989)

CS Issues:
Pens

- Pens for very large (wall-sized) displays (not tethered, with back-projection)
- Uses of devices are casual, without training, natural, simultaneous by several users

CS Issues:
Network Protocols

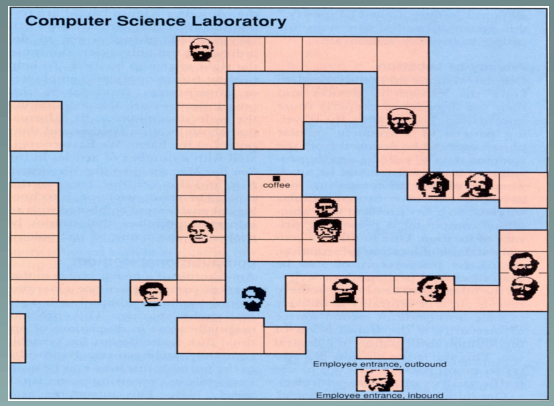
- Wireless media access protocol (cellular topology, guaranteed bandwidth)
- Wide bandwidth range (Gb / sec)
- Real-time protocols for multi-media appls.
- Internet routing protocol (IP) not sufficient for highly mobile devices

CS Issues: Interaction

- Virtual keyboards for Tabs
- Location-independent GUIs for Liveboards
- Mobile X-Windows across several servers
- Adaptation to variable network bandwidth (window-migrating applications)

CS Issues: Applications

- **Locating people for video annotation and dynamic maps (Active Badges)**
- **Shared meeting (drawing) tools**
- **„Responsive Environment“ project (adaptive heat, light, power regulation in buildings)**
- **Virtual communities (MUDs)**
- **Invisible collaboration (via crowd behavior)**



CS Issues:
Privacy of Location

When users / devices are tracked, people's privacy can be invaded.

- Central tracking database vs. decentralized database (let users control their own data on their own PC)

CS Issues: Computational Methods

- Optimal cache sharing

Discussion of Paper

Important, early contribution.

Good:

- Overall philosophy
- List of CS issues

Not so good:

- Approach (researchers as guinea pigs)
- Few („white collar“) applications