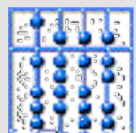# Herding Sheep:
Live System Development for Distributed Augmented Reality

ISMAR 2003, Tokyo, Japan

10.9.2003

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Introduction

- More and more AR systems are built using frameworks:
  - Repo-3D, Studierstube, Tinmith, MR Platform ...
- DWARF framework is unique regarding:
  - Flexibility at runtime
  - Distribution among different hosts/operating systems
  - Introspection facilities
  - Easy adaption of third-party software

- What is SHEEP?
  - The „Shared Enviroment Entertainment Pasture"
  - Distributed multiplayer game with variety of multimodal interactions
- Why SHEEP?
  - AR games are not new: Cow Painting, ARQuake, AquaGauntlet ...
  - Evaluation and refinement of architectural claims
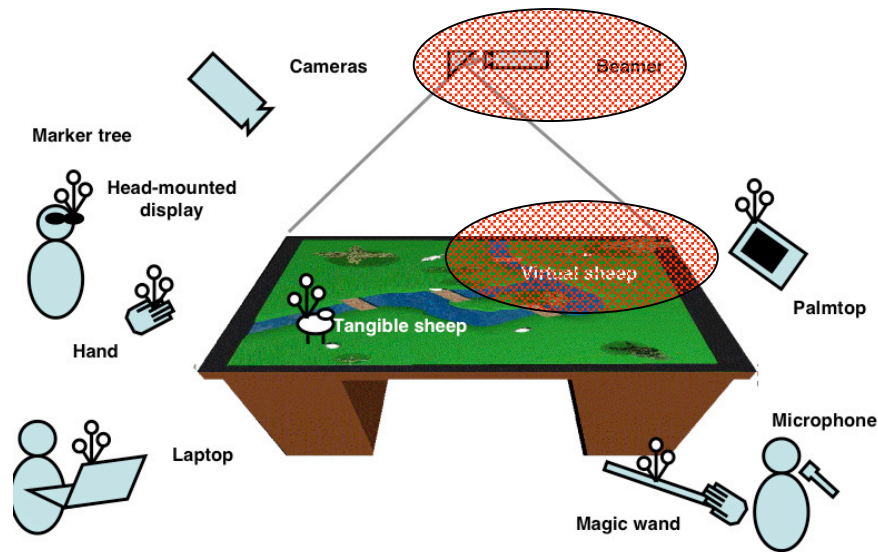 - Testdrive for new development process
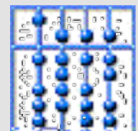
Outline

- ## The Game
  - Shows the game from the user's perspective

- ## Framework Level
  - System Architecture
  - Subsystem Details

- ## Process Level
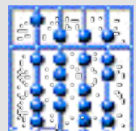 - Methodology
  - Tools

- ## Conclusion
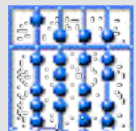
The Game

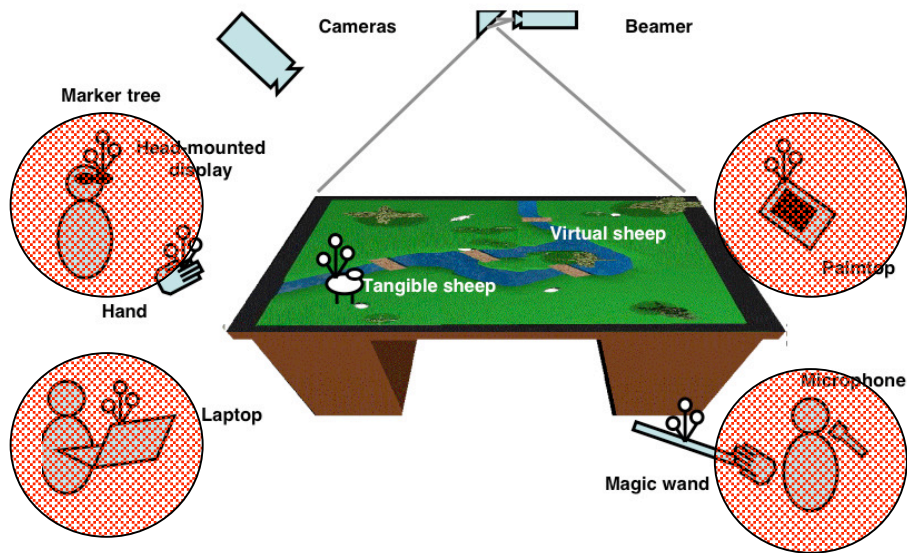Landscape containing virtual
sheep is projected onto a table

The Game

Players have a variety of devices for interaction
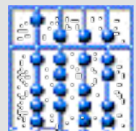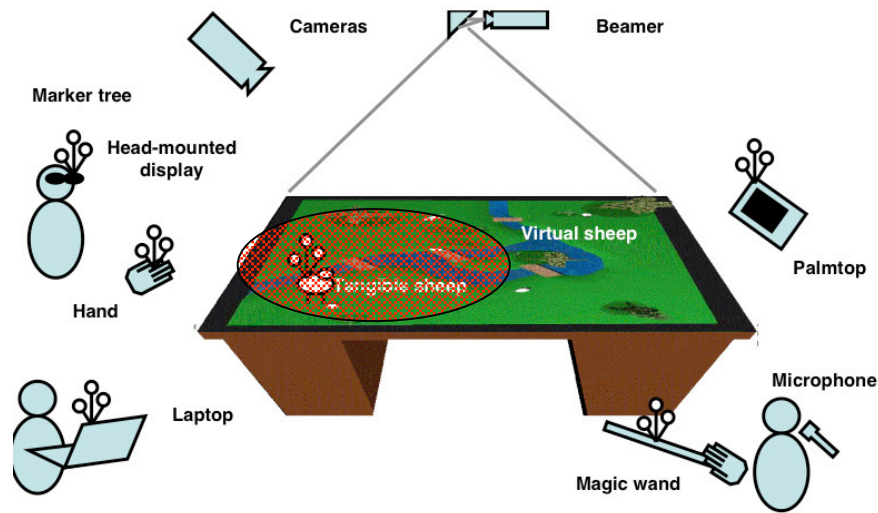
The Game

A tangible plastic sheep attracts the virtual sheep
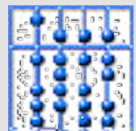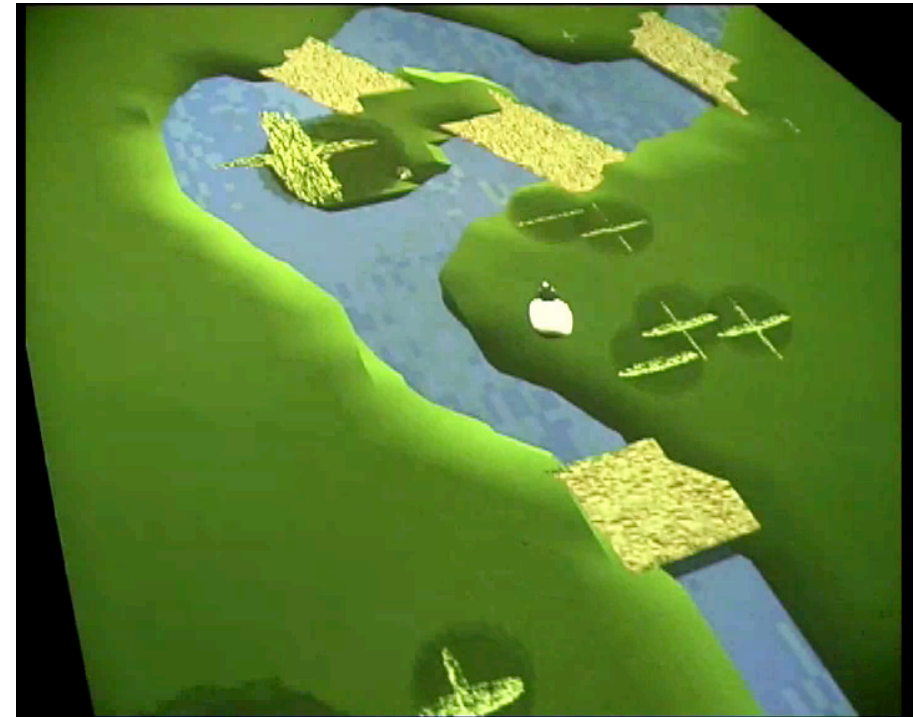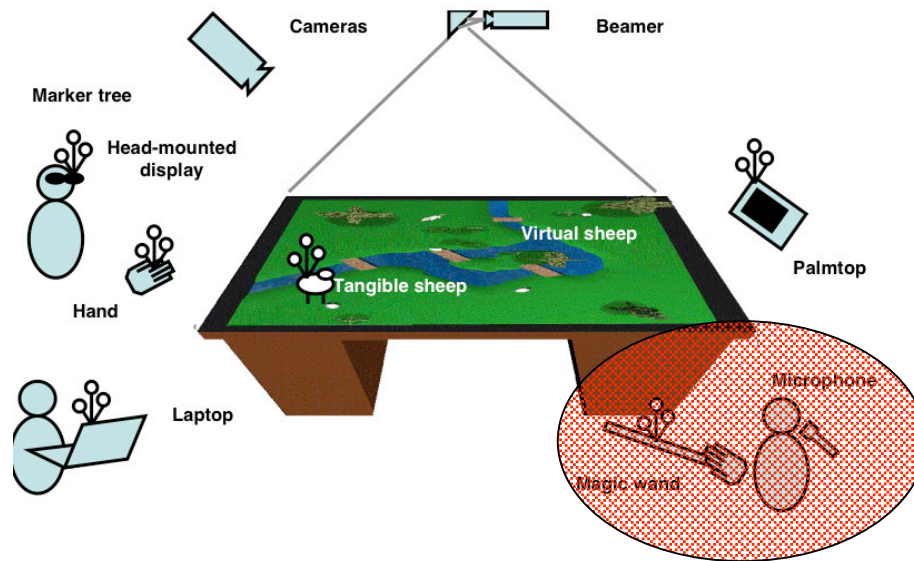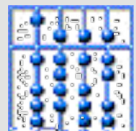
The Game

Point-and-Speak is used to create and remove sheep
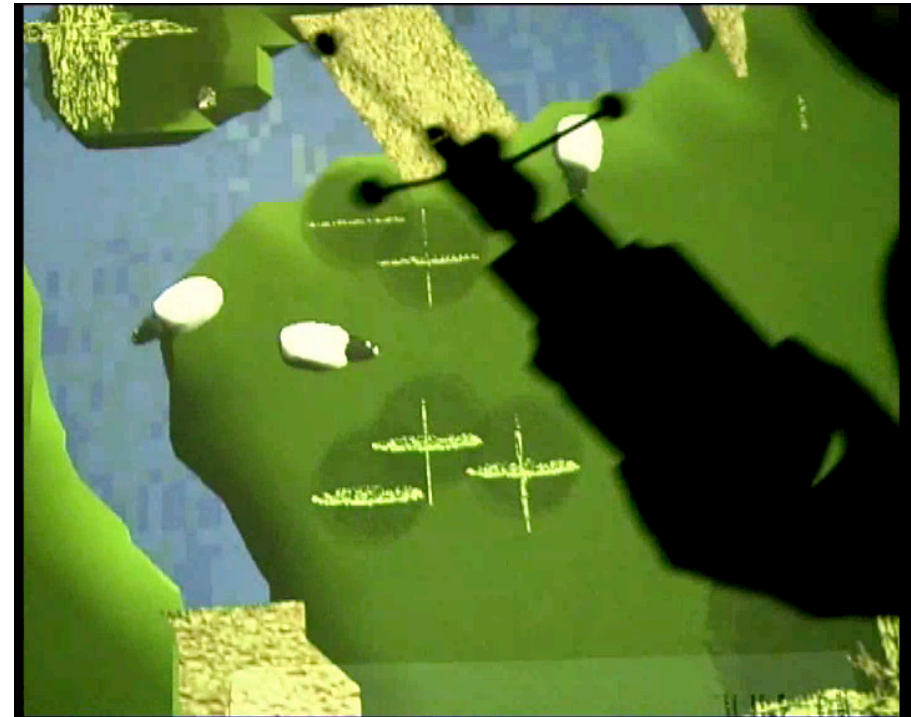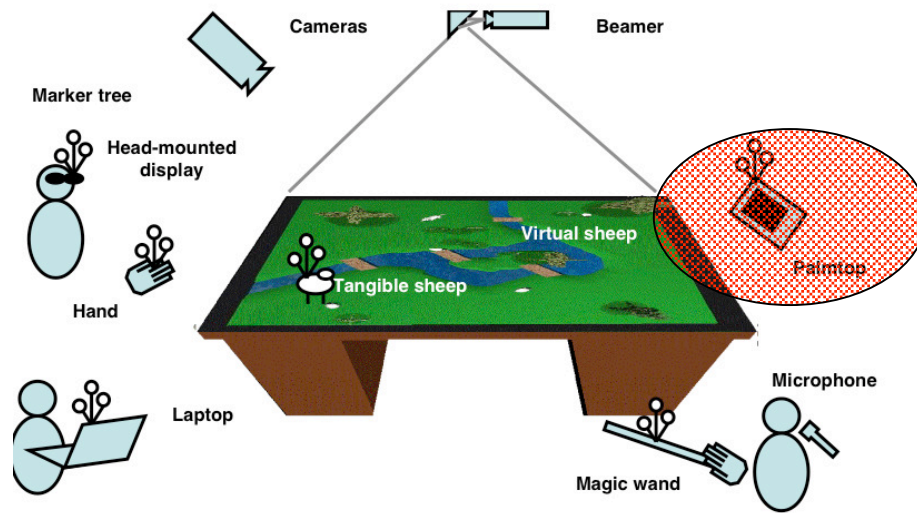
The Game

Sheep can be scooped and
dropped with an iPAQ
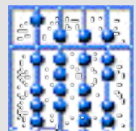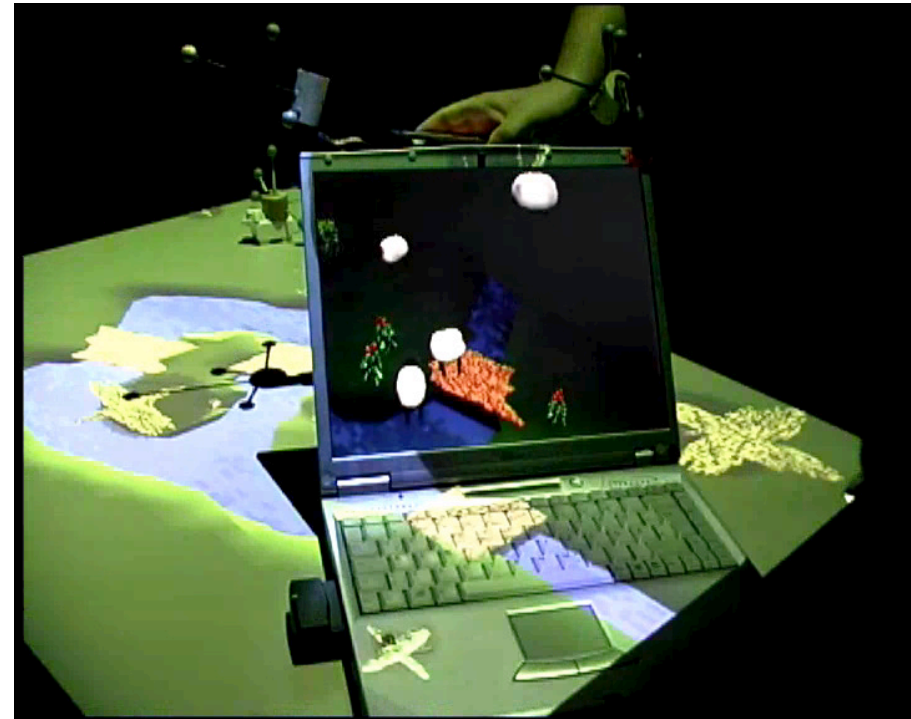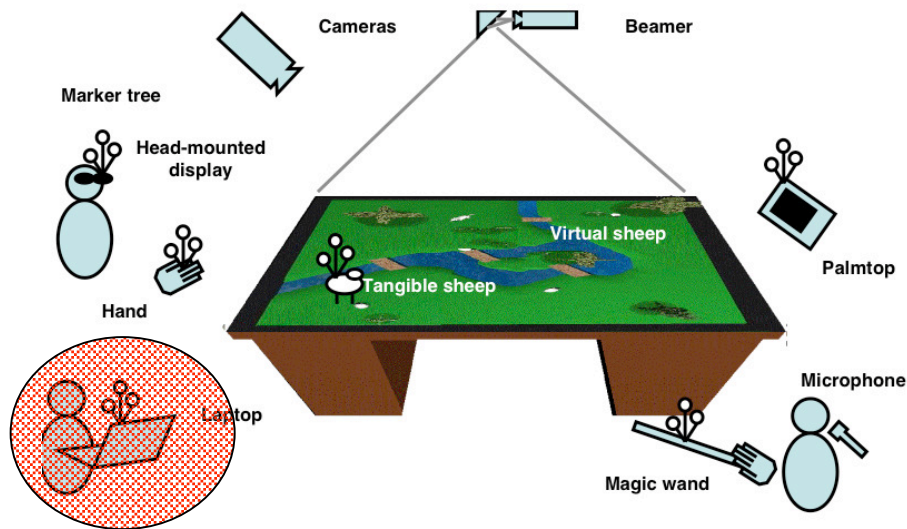
The Game

A tracked laptop as window to the virtual world
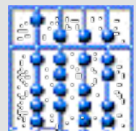
The Game
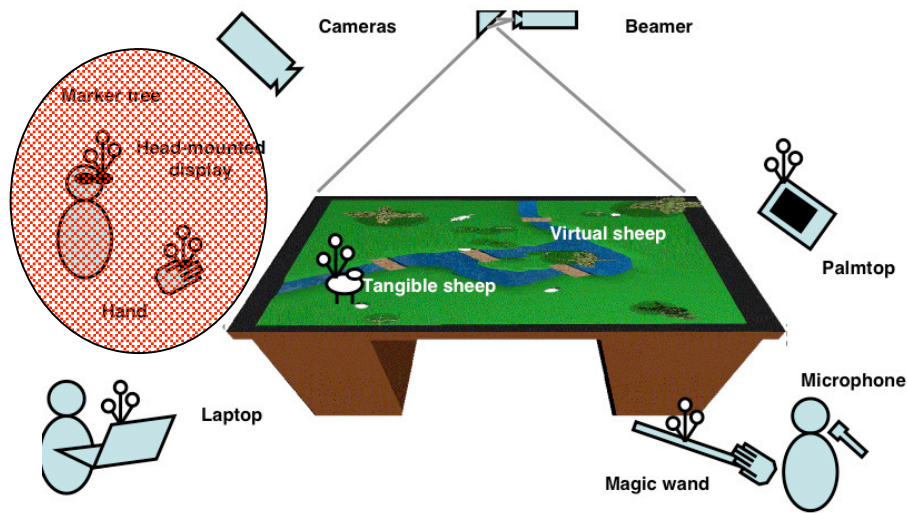
Color of sheep can be changed
by user wearing an HMD
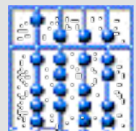
System Architecture (1) - Subsystems
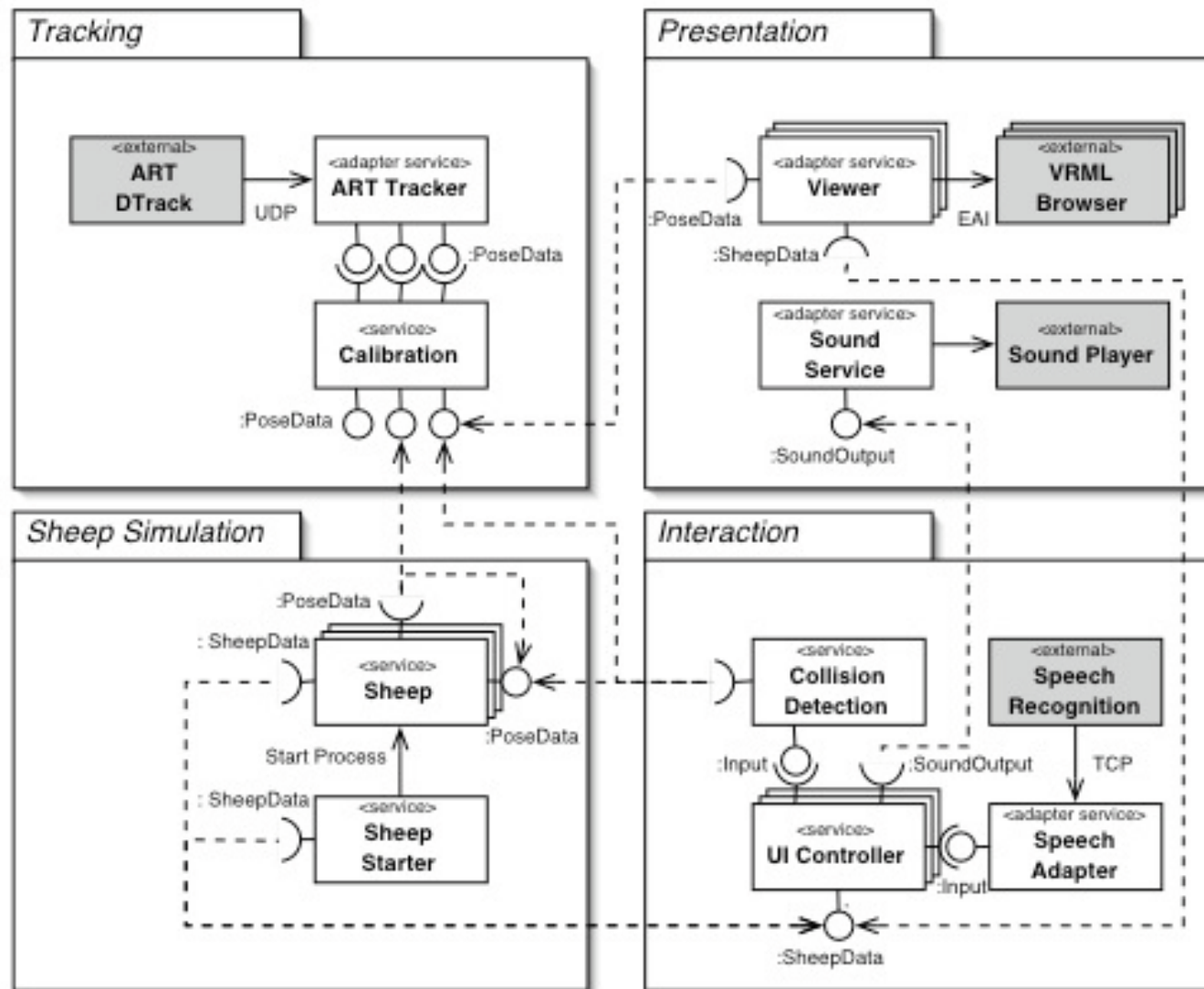
System Architecture (2) - Deployment
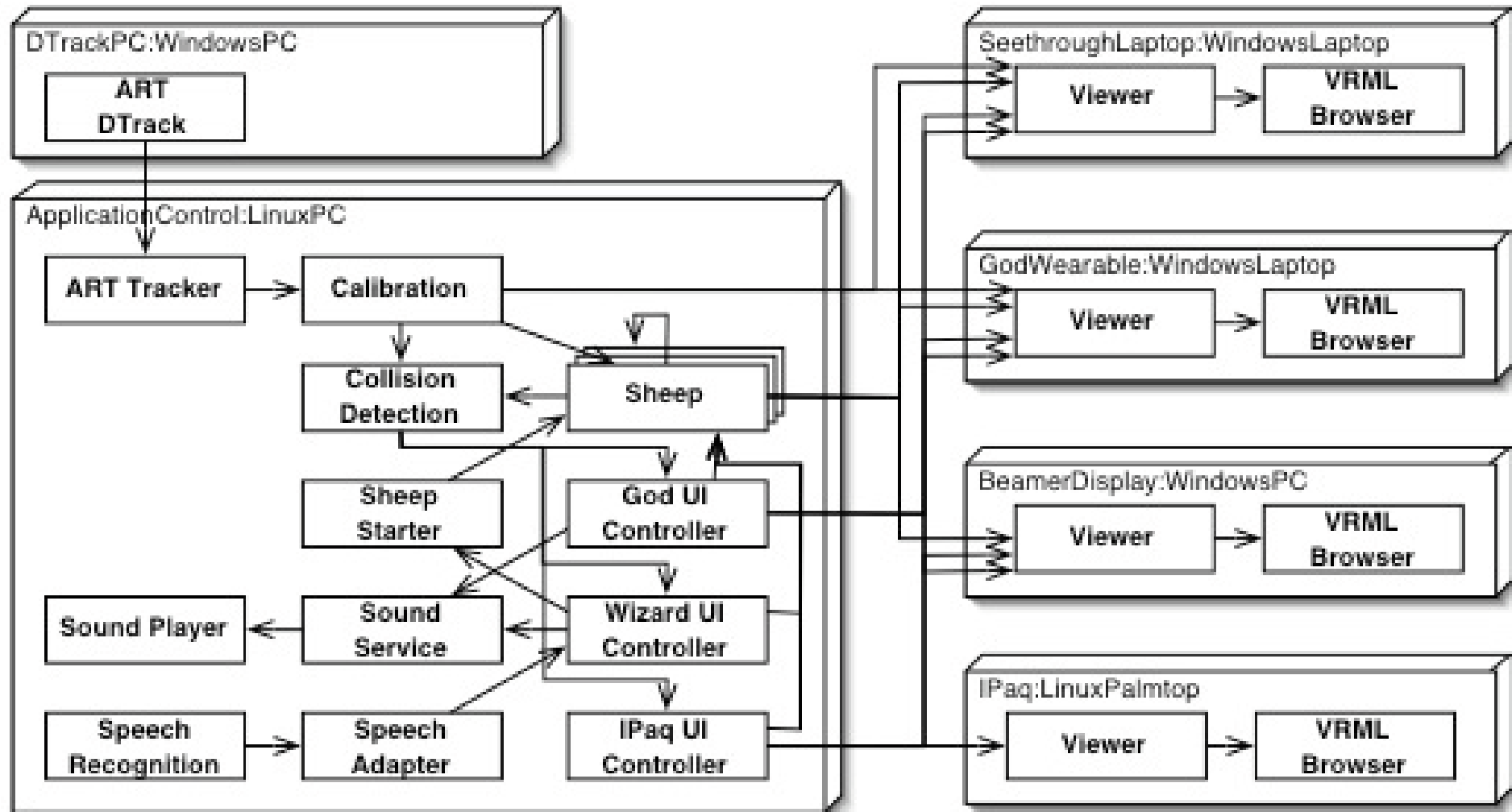
Subsystem Details (1)

- ## Sheep Simulation
  - Based on distributed variant of flock of birds algorithm [Reynolds 1987]

- ## Tracking
  - Dtrack system (ART GmbH) delivers raw pose data
  - Pipe-filter tracking architecture using DWARF event bus
  - Calibration component unifies coordinate systems, one-step calibration using a pointing device
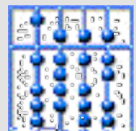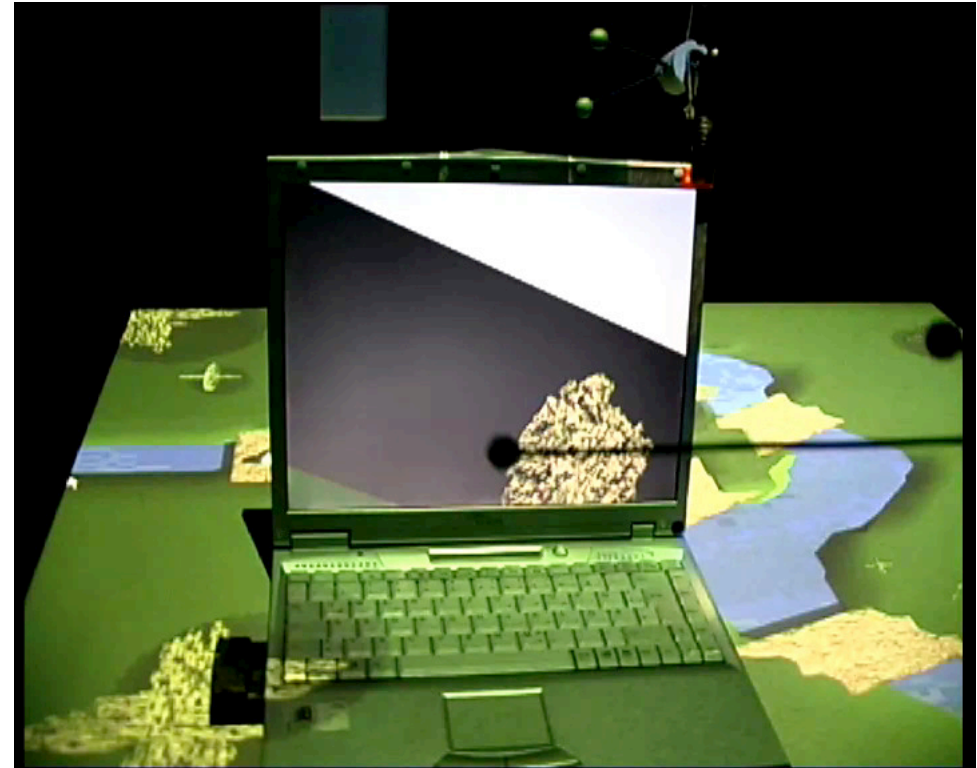
Subsystem Details (2) - Visualization

- VRML browsers with DWARF/EAI adapter
- Two types of browsers:
  - Windows/Intel: Cortona from Parallelgraphics
  - Linux/StrongARM: FreeWRL
- Distributed Scenegraph realized through manual synchronization
- Problematic limitations of:
  - OpenGL/Java on iPAQ
  - EAI
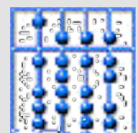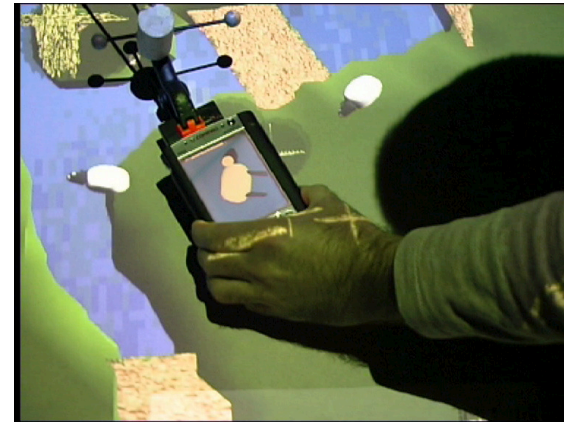
Subsystem Details (3) - Interactions

- User Interface Controller: Conversion of multimodal input into commands

- Internal structure: Petri-Net

  - Graphical output during runtime
  - Based on Petri-net framework jfern (XML and Java)
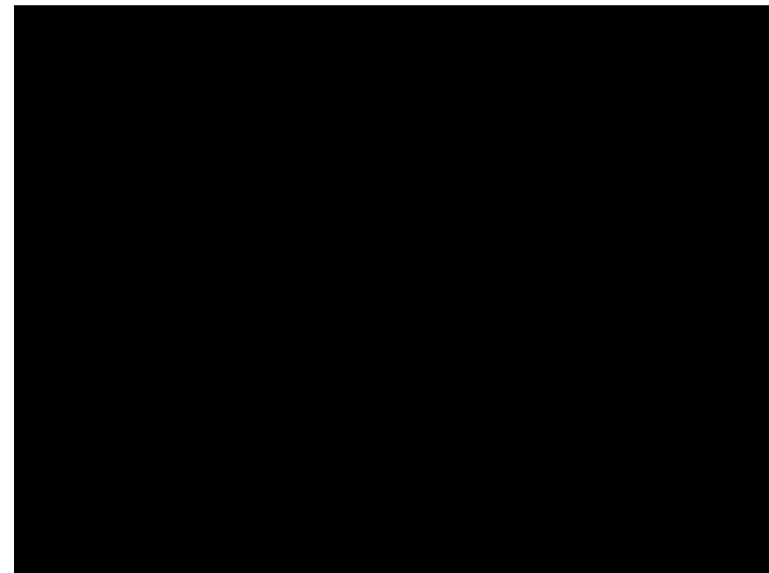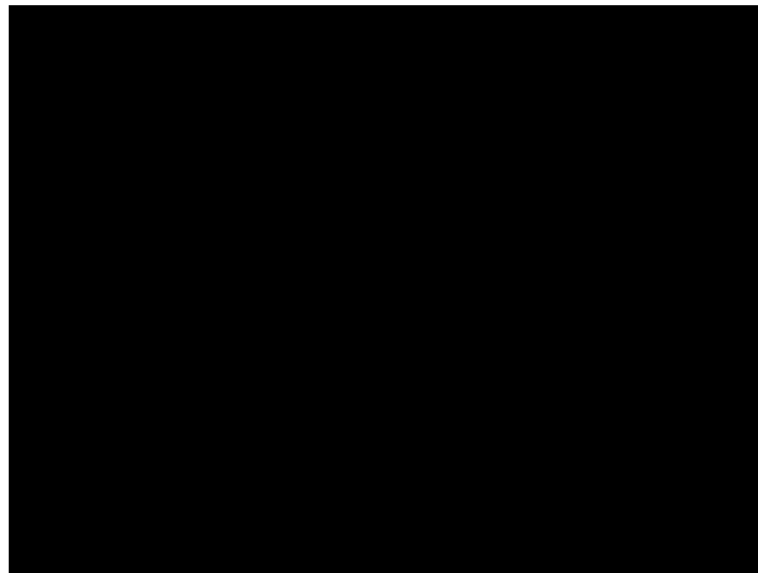
Development Methodology

- Incremental development of running system
- Continuous integration of evolving components
- System design during implementation
- Jam Sessions: Interaction design and evaluation during runtime
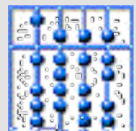
Supporting Tools

- One-step calibration with magic wand
- Monitoring:
  - UI: User Interface Controller
  - Overall system state
- Testing:
  - Tracker simulation
  - Component simulation

Results

- ## The game:
  - Shown publicly at various occasions, first at ISMAR 2002 in Darmstadt.
  - User Feedback
    - Tangible User Interfaces with magical metaphors are easy to use
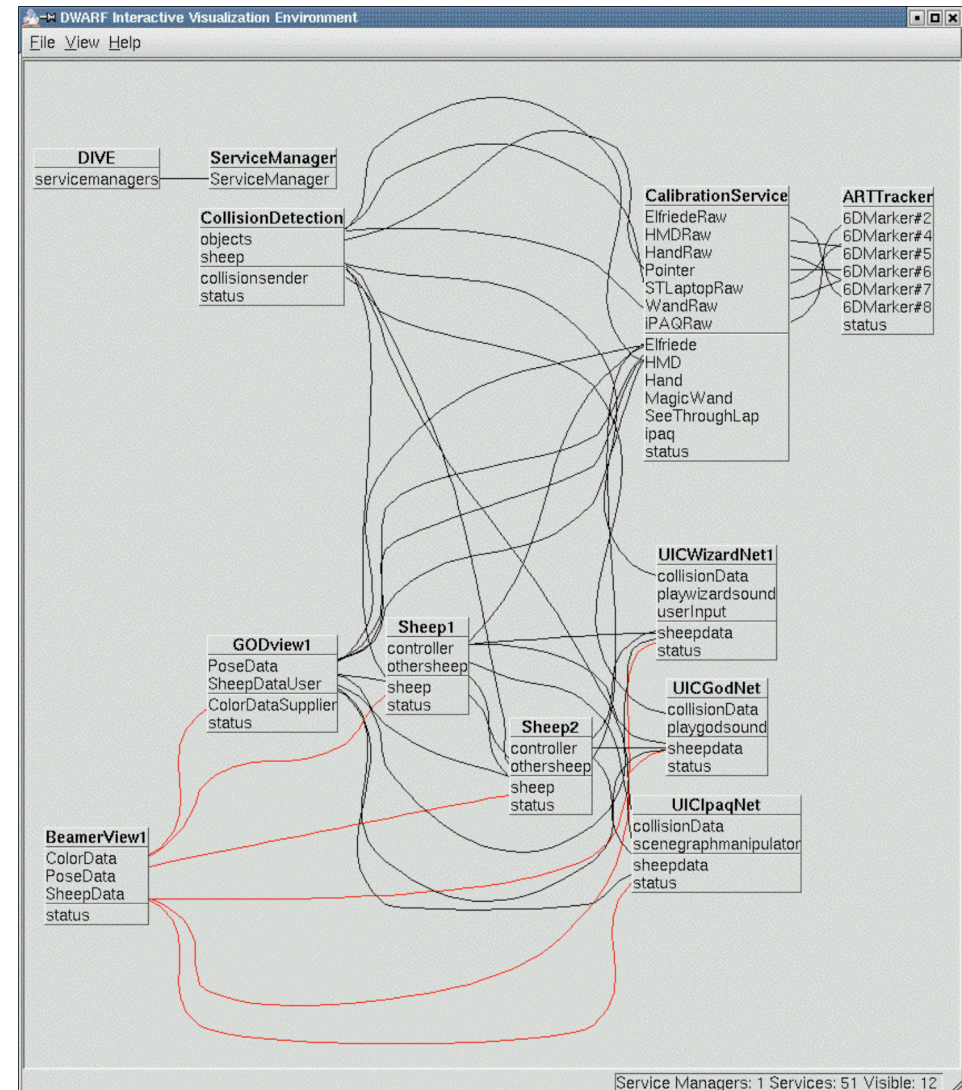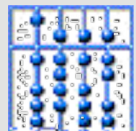   - Direct interaction with head-fixed widgets is bad
    - Immediate feedback is important (graphical and acoustical)

- ## The framework:
  - Overall concepts validated
  - Single components still need improvement

- ## The process:
  - Still work in progress
  - Jam Sessions are fun and productive
  - Introspection facilities are very useful for debugging

Future Work

- Game extensions:
  - Saving sheep from wolf and falling off the table
  - Landscape manipulations
- Conduct usability studies:
  - Consolidation of metaphors
  - Runtime usability evaluation tool
  - Interaction library for User Interface Controller
- Process:
  - Formalization and thorough evaluation
  - Further speedup of prototyping with new tools (Python[1])

- Integrate recent DWARF improvements into SHEEP:
  - OpenInventor-based viewer
  - World model: Consistent data storage
  - Better calibration (SPAAM)
  - Middleware: Automatic component startup
  - Mac OS X/Windows support

[1]Special thanks to Joe Newman (TU Wien)
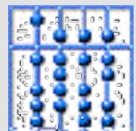
End of Talk

- Why not start with DWARF today?
- Project homepage

  http://www.augmentedreality.de

- Please ask your questions!
  質問をどうぞ！ただし英語でお願いします。