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SHEEP

The Shared Environment Entertainment Pasture

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System Design

The entire SHEEP system is realized with DWARF, a framework for building flexible distributed augmented reality applications. The basic components of SHEEP are DWARF services, shown in blue.

For some services, only one instance at a time is running, e.g. the tracking services. For others, a fixed number is running, e.g. one user interface controller for each user or one VRML manipulator for each display. Finally, for some, any number can run at a time, e.g. the sheep.

Many of the DWARF services form adapters to connect to third-party software (shown in gray).

The services run on several different machines running Linux, Windows and Mac OS, and are written in Java and C++. They use CORBA-based middleware to find each other and connect to one another dynamically.

...Can you count how many services there are altogether?

SHEEP playfully explores the possibilities of multimodal, multiuser interaction with wearable computing in an intelligent environment.

The Game: tangible and virtual sheep in a pastoral landscape. Look at them, move them around, pick them up, paint them, create new sheep, or remove them.

The Framework: DWARF, a collection of peer-to-peer, dynamically cooperating services for AR on stationary, mobile and wearable computers.

...Try it out!

Other DWARF Projects

DWARF is an ongoing research project at the TU München, started in early 2000. It provides a research platform for wearable context-aware systems, with focus on augmented reality, multimodal interaction and self-assembling systems.

As a framework, DWARF is useful for building flexible prototype systems, especially in research or student projects. It has been used at TU München to build several systems so far:

- Pathfinder – for campus navigation
- Fata Morgana – for automobile visualization
- TRAMP – for mobile automobile maintenance
- FixIt – for robot inspection and diagnosis
- SHEEP – for pastoral entertainment.

...What's* your *DWARF application?

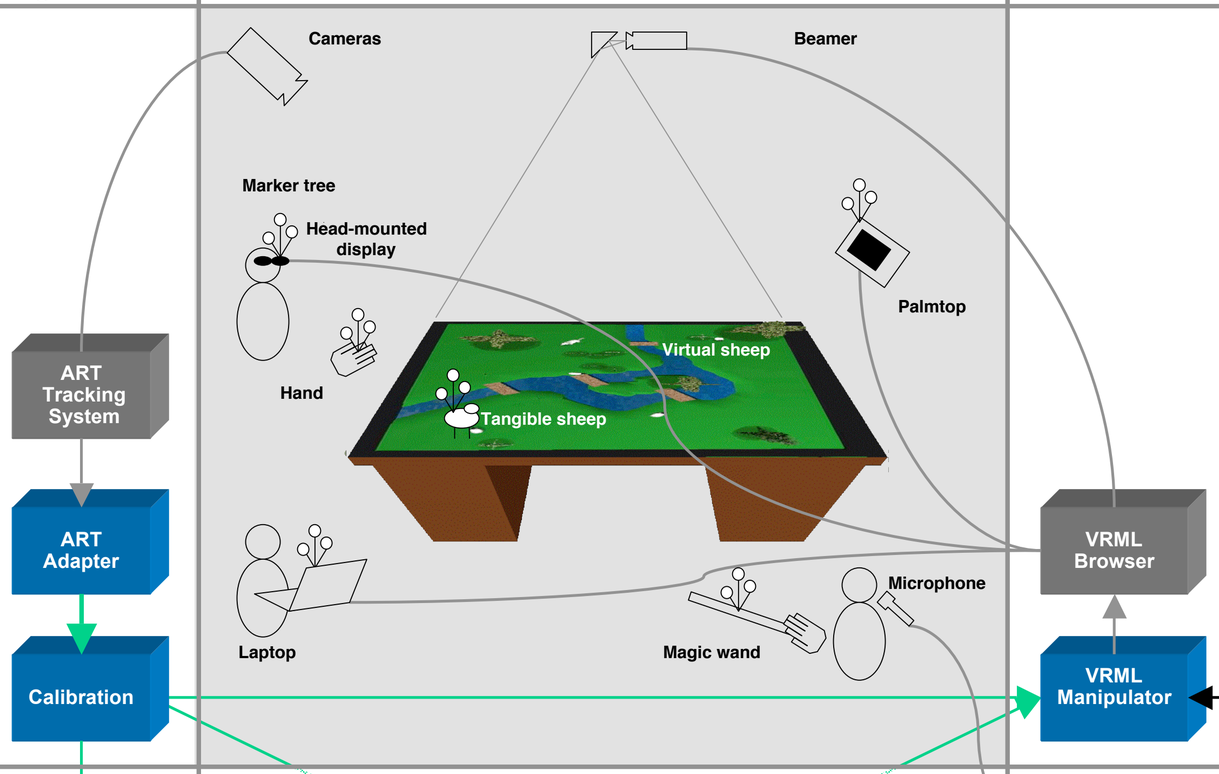
Tracking

Retroreflective optical marker trees are attached to the head-mounted display and the user's hand; the laptop and palmtop; the magic wand, and the tangible sheep.

A four-camera infrared tracking system from ART GmbH determines each marker tree's pose with millimeter accuracy and up to 60 Hz. The raw data is converted into DWARF's internal pose data format (green arrows), and a simple calibration service transforms it into viewpoint coordinates for the other services.

Thanks to the ART system's high precision, a one-step calibration process is possible.

...Can you re-calibrate our tangible sheep?



Visualization

The sheep and the landscape are shown in three dimensions using a ceiling-mounted beamer, a tracked head-mounted display, a tracked "see-through" laptop and a palmtop computer.

The three-dimensional scenes are modeled in VRML and displayed through the Cortona and FreeWRL VRML browsers.

The DWARF VRML manipulator services modify the scenes in response to tracking data, sheep movements and user input.

...Can you find a wire-frame sheep?

...Can you find our DWARF mascot?

Sheep Simulation

One single tangible, "real" sheep is on the table and is tracked, all others are simulated. Together, the tangible and virtual sheep form a herd that moves around in the landscape.

Each virtual sheep is aware of the others' position. The sheeps' motion is determined by the desire to stay close to each other and avoid collisions with each other.

The virtual sheep are implemented as individual DWARF services running in separate processes. When the user creates a new sheep, a new process is launched.

...Can you make the herd cross the river?

Communication

The entire system is distributed over several computers connected with wired and wireless ethernet.

The DWARF services are realized as separate processes or threads within single processes. Distributed middleware, consisting of CORBA and several DWARF service managers, connect the services together.

Upon startup, each service registers itself, via CORBA, with its DWARF service manager running on the local machine or a specified remote host.

The service managers running on the different machines communicate with one another using SLP and CORBA and set up connections between the services. The services then use CORBA method calls or CORBA notification service events to communicate.

The communication channels are shown in green (pose data), black (other events and method calls) and gray (communication using non-DWARF protocols).

...Can you see which services are running?

Interaction

The tangible sheep can be moved directly and influence the virtual sheep. With the palmtop, you can scoop a virtual sheep off the pasture and put it down somewhere else.

With the magic wand and speech recognition, you can create new sheep or remove them. Using the head-mounted display and your tracked hand, you can change a sheep's color.

Speech and tracking information are used as input devices to a user interface controller for each user, which changes the state of the displays and sends events to the sheep.

...Can you color a sheep red?

...Can you create a new sheep?

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DWARF

Distributed Wearable Augmented Reality Framework
www.augmentedreality.de