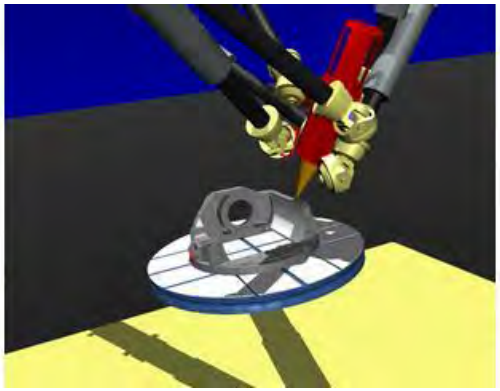
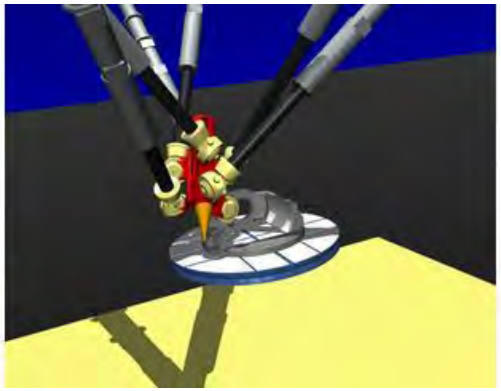
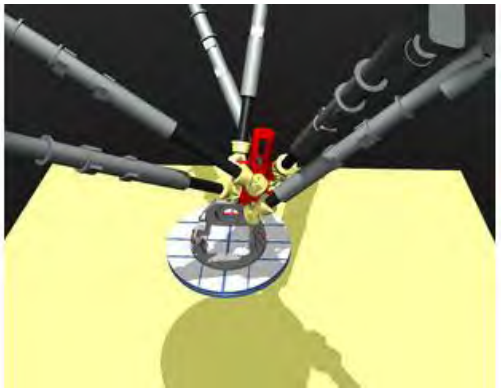
instantReality

Framework for AR and VR application

Johannes Behr

Fraunhofer IGD – A4

Johannes.Behr@igd.fraunhofer.de

Fraunhofer Institut Graphische Datenverarbeitung

Qualitätsmanagement zertifiziert nach DIN ISO 9001:2000

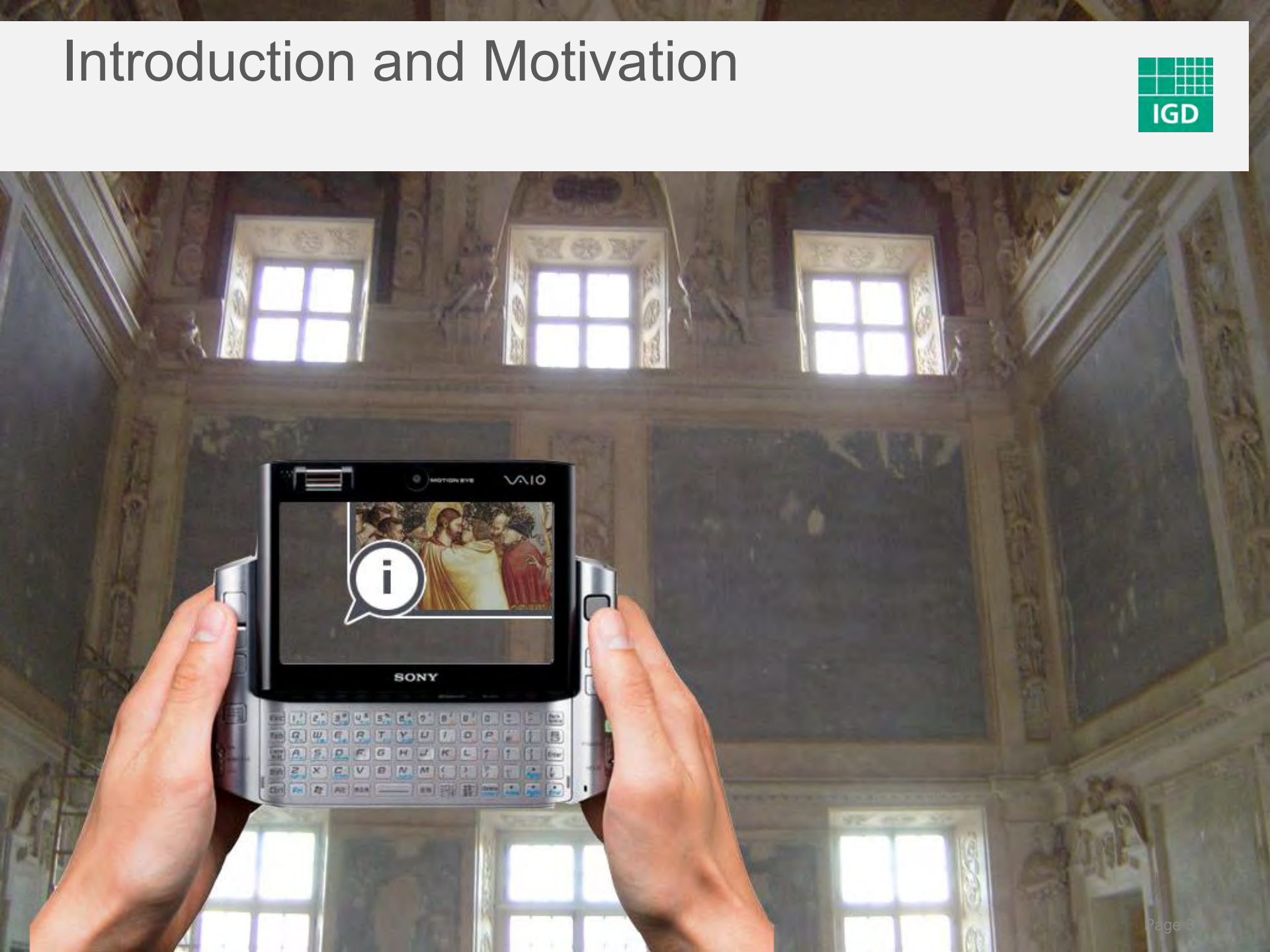
Introduction and Motivation

System-feature and Architecture

Application example

Current status and future developments

Introduction and Motivation



Fraunhofer Foundation

57 Institutes doing application oriented research and development

Fraunhofer Foundation

- Mission: “Application oriented research for industry and advantage of our society “
- Figures 2008
  - 80 research units
  - 57 Institutes
  - 15 200 Employees
  - 1.4 Billion € Budget
    - 2/3 research projects for industry
    - 1/3 public funding

Institute for Computer Graphics, Darmstadt

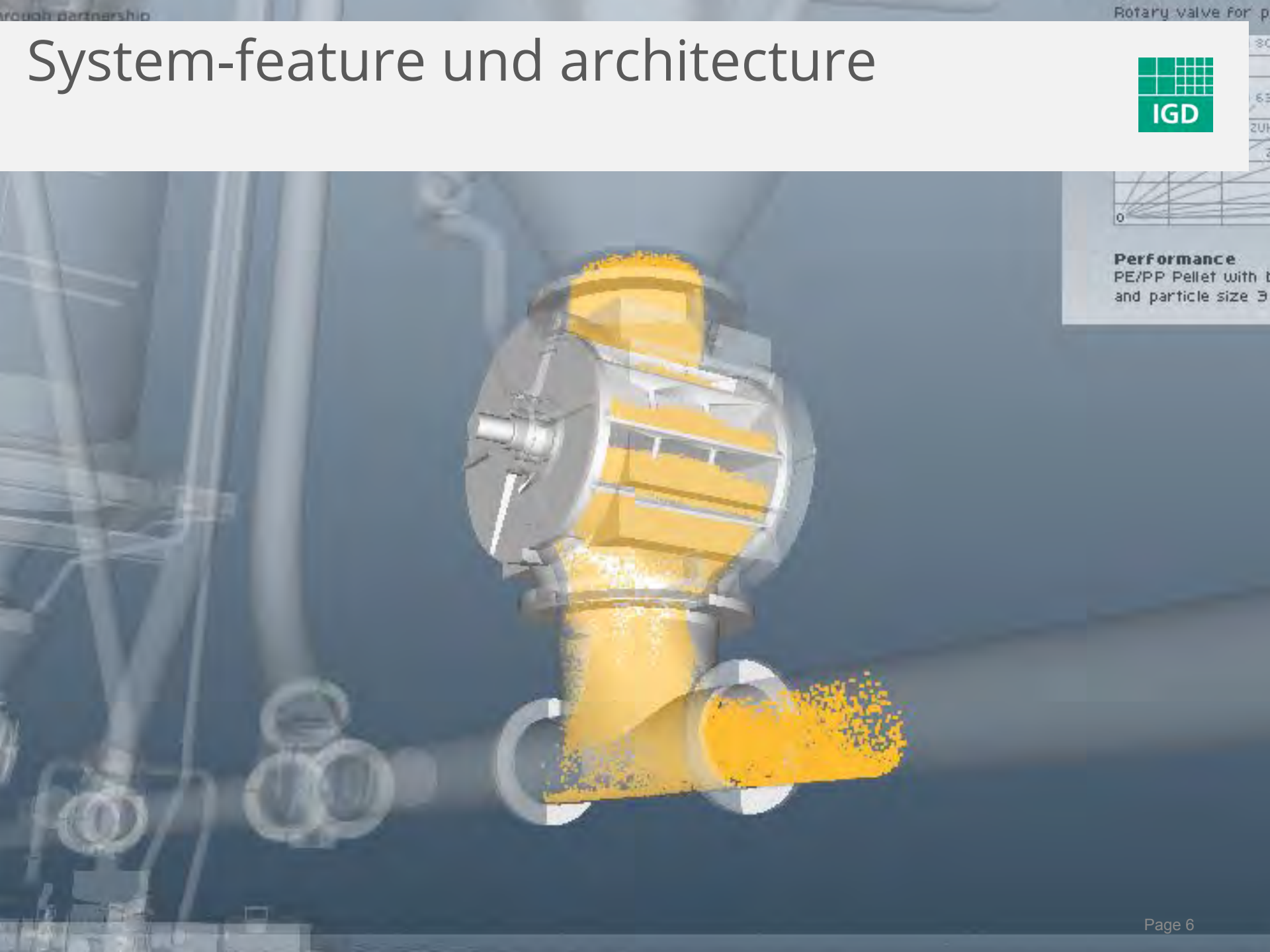
- 120 Employees
- 20 Employees in VR/AR Group

Fraunhofer IGD

15 Years VR/AR development

- 1st Generation
  - 1992 start of VR-Activities
- 2nd Generation
  - 1995 1st Fraunhofer VR System (coop VW/BMW)
  - 1997 First 5 sided CAVE in Germany
  - 1998 Founding VR-Spinoff: VR-COM
- 3rd Generation
  - 2000 OpenSG (LGPL Scene Graph)
  - 2003 HEyeWall 1.0 (18 Million Pixel, 48 PCs)
  - 2005 InstantReality VR/AR Middleware
  - 2008 HEyeWall 2.0 (35 Million Pixel, 48 PCs)

System-feature und architecture



Requirements for the 3rd gen system

Problem: Wide variety of topics and feature-requests

Distributed Systems

Multi-Core/GPU

Indoor-AR

Outdoor-AR

Multi-Sensor net.

Large-Model vis.

Dialog-systems

Edutainment

Prototyping

Requirements for the 3rd gen system

Scalability is key-requirement

Interaction und Navigation:

from: Single local sensor

to: Dynamic and distributed Sensor-Fusion networks

Rendering und Visualisation

from: Mobile systems

to: Distributed Multi-Screen/CPU/GPU-systems

Complexity of the application-logic and behaviour

from: Walkthrough or examine of static data

to: Complex and non-linear edutainment-application

Requirements for the 3rd gen system

Efficient and flexible application development

Costly application development cycle in 1st and 2nd gen systems

- Fix Application Modules (e.g. Design-Review, Assembly/Disassembly)
- New Modules had to be developed in C/C++
- No clear distinction between application and system development

Efficient and flexible application development is key-requirement

- Application prototyping is imported for Industry and R&D
- Clear cut between system and application development-layer
  - To maximize the functionality in the system layer
  - To minimize the complexity in the application layer

System-feature and architecture

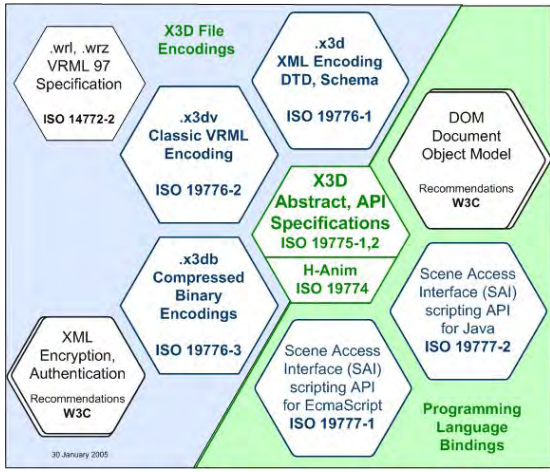
X3D as basis for the application description layer

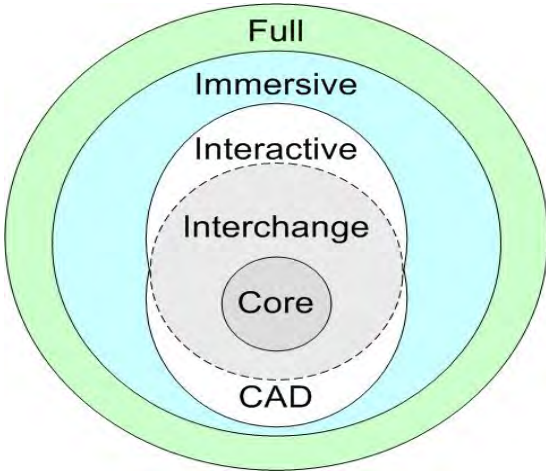
There is no standard for VR/AR Application dev

Our Solution: Utilize standard from close domain

X3D ISO Standard (describes an abstract functional behavior and time-based interactive 3D environment)

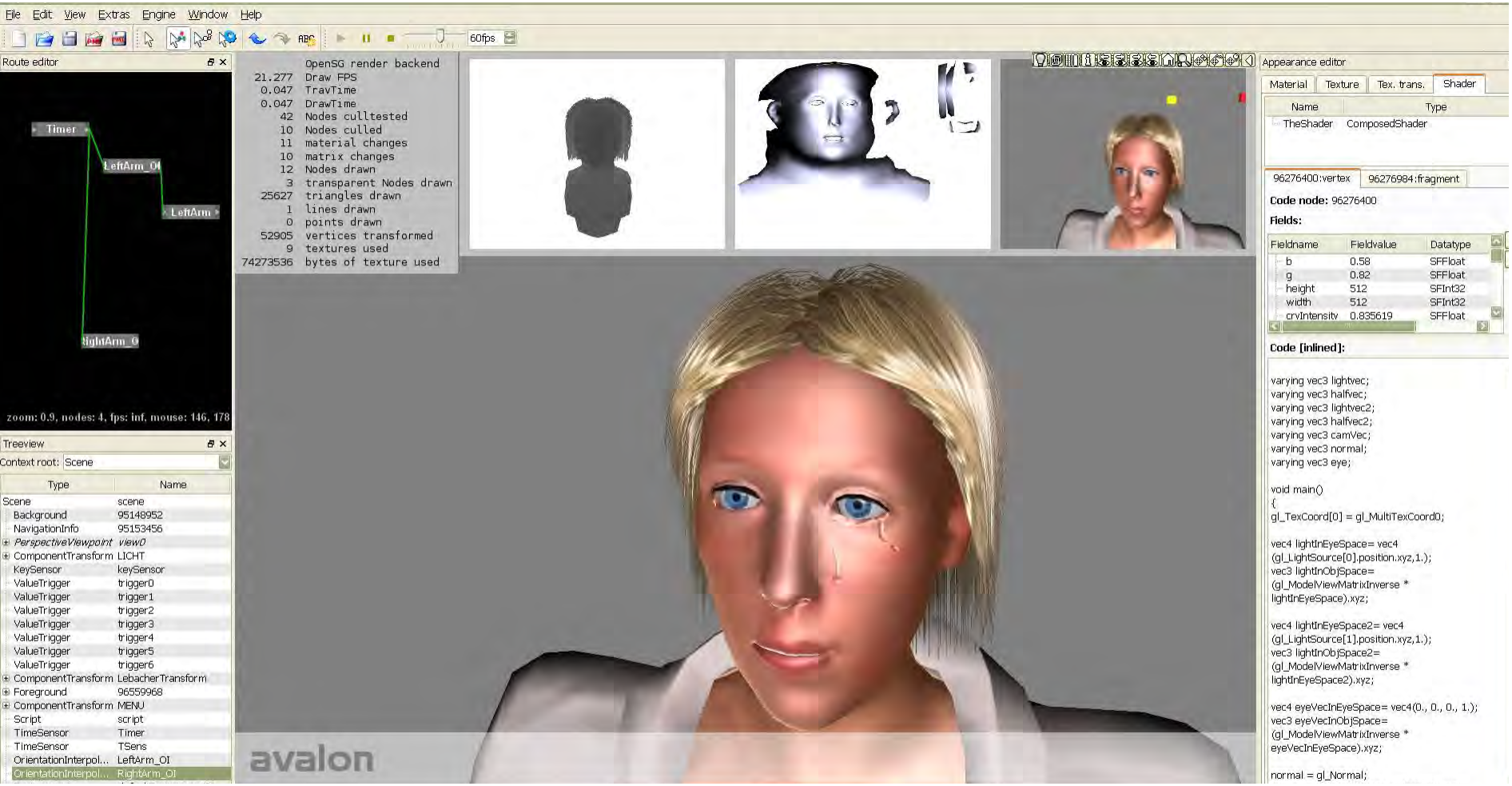
- Designed to be extensible
- (Multi-parent) Szenen-Graph
- Behaviour-Graph
- Scripting und Prototyping
- Device independent
- XML/ascii/binary – Data-Encodings
- > 200 node-types in 40 components (e.g. NURBS, Volume-Rendering, Physics (RBD), glsl/cg/cgfx-Shader)





System-feature and architecture

X3D as basis for the application description layer



System-feature and architecture

X3D runtime for AR/AR Application

Desktop runtime

- WIMP environment with mouse & keyboard
- Single screen per application
- Application interfaces only with browser

Immersive VR environment

- No WIMP interface
- Wide range of IO devices and interaction methods
- Multi Screen/Pipe and Cluster setups
- Distributed applications

System-feature and architecture

Interaction and Navigation

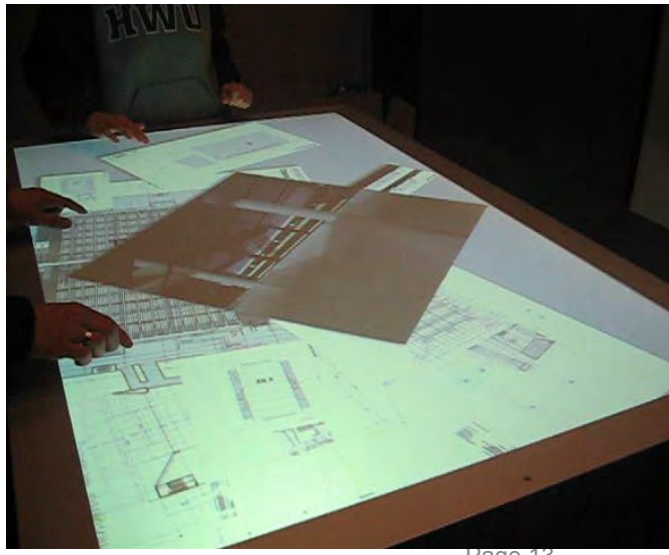
High-Level: Virtual Object Sensors

- Device and Device-class independent
- Extents X3D PS-Concept
- Supports Multi-Touch/User/Hand

High-Level: Navigator and NavigationEval

Low-Level: Data-stream Sensors

- Network transparent
- Dynamic reconfiguration
- Support > 30 VR devices
- Vision Subsystem (e.g. Marker- and Natural-Feature-Tracker)



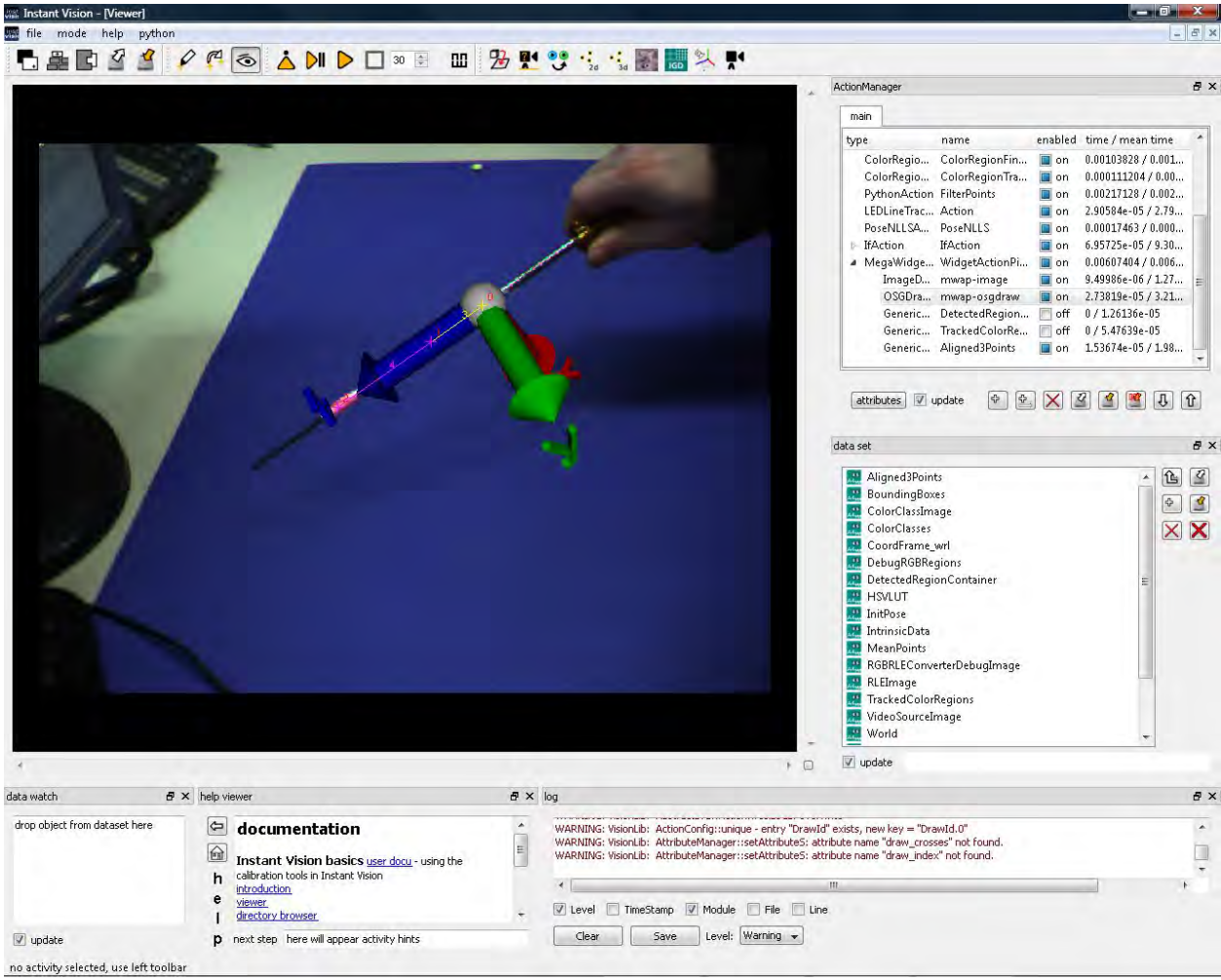
System-feature and architecture

instant**Vision**: Vision based tracking

Subsystem for Vision-based tracker

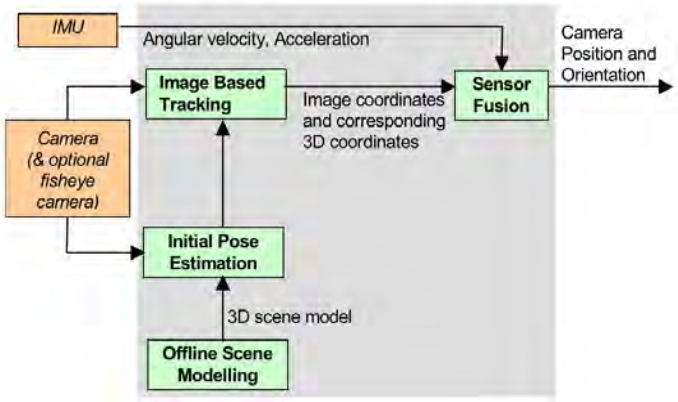
Instant**Vision**: composing, testing and tuning of visual tracking pipeline

Support for marker, poster and different natural-feature tracker (e.g. line-tracker, KLT)



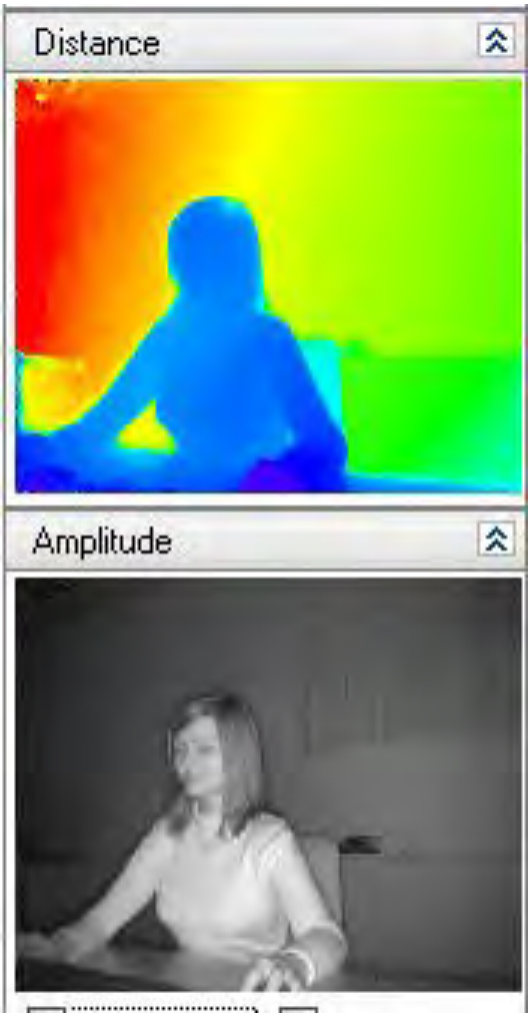
System-feature and architecture

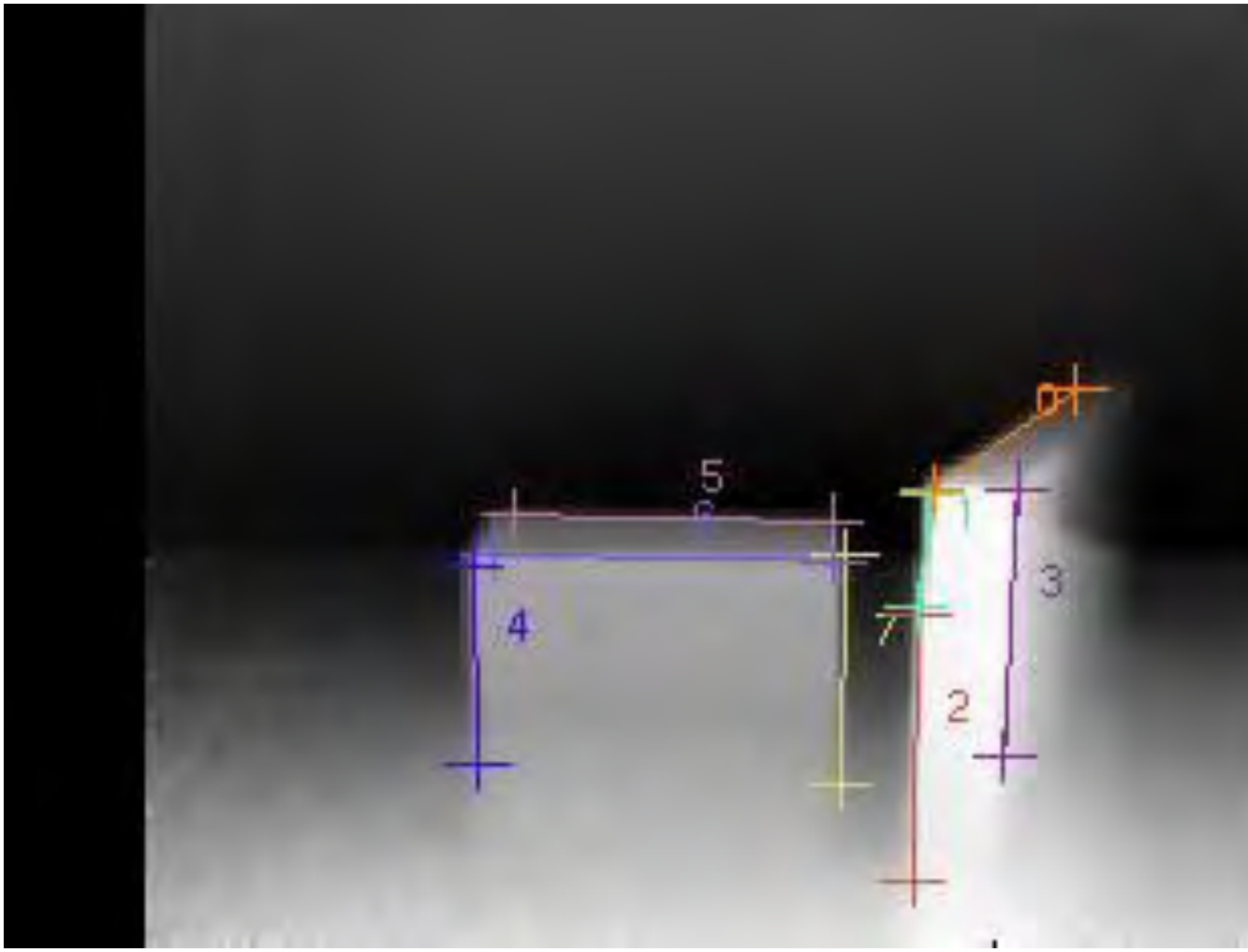
InstantVision: Robust and Markerless Tracking



System-feature and architecture

InstantVision: Feature reconstruction from 2.5D TOF data

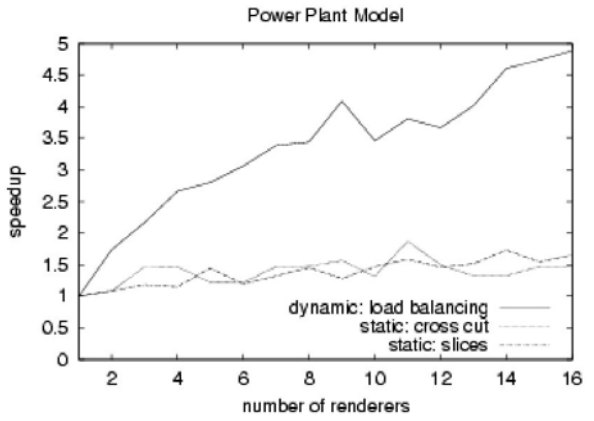




System-feature and architecture

Distributed rendering using PC-Cluster

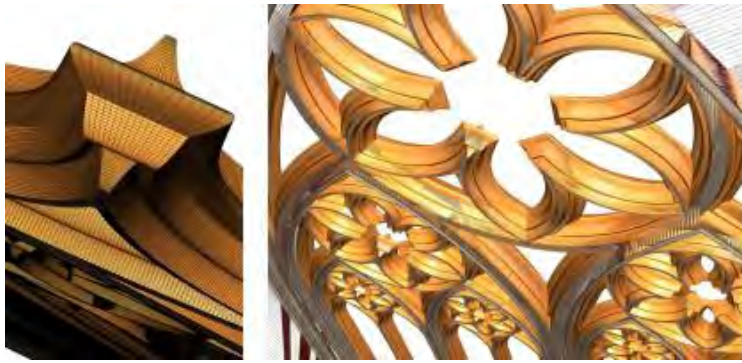
- Base-feature of OpenSG
- Transparent for Application developer
- Support for Sort-First and Sort-Last
- Dynamic load distribution
  - Fully automatic method
  - Scales almost linear with any number of CPU/GPU boxes
  - 2x to 5x performance increase with typical CAD data



System-feature and architecture

Generic X3D extensions

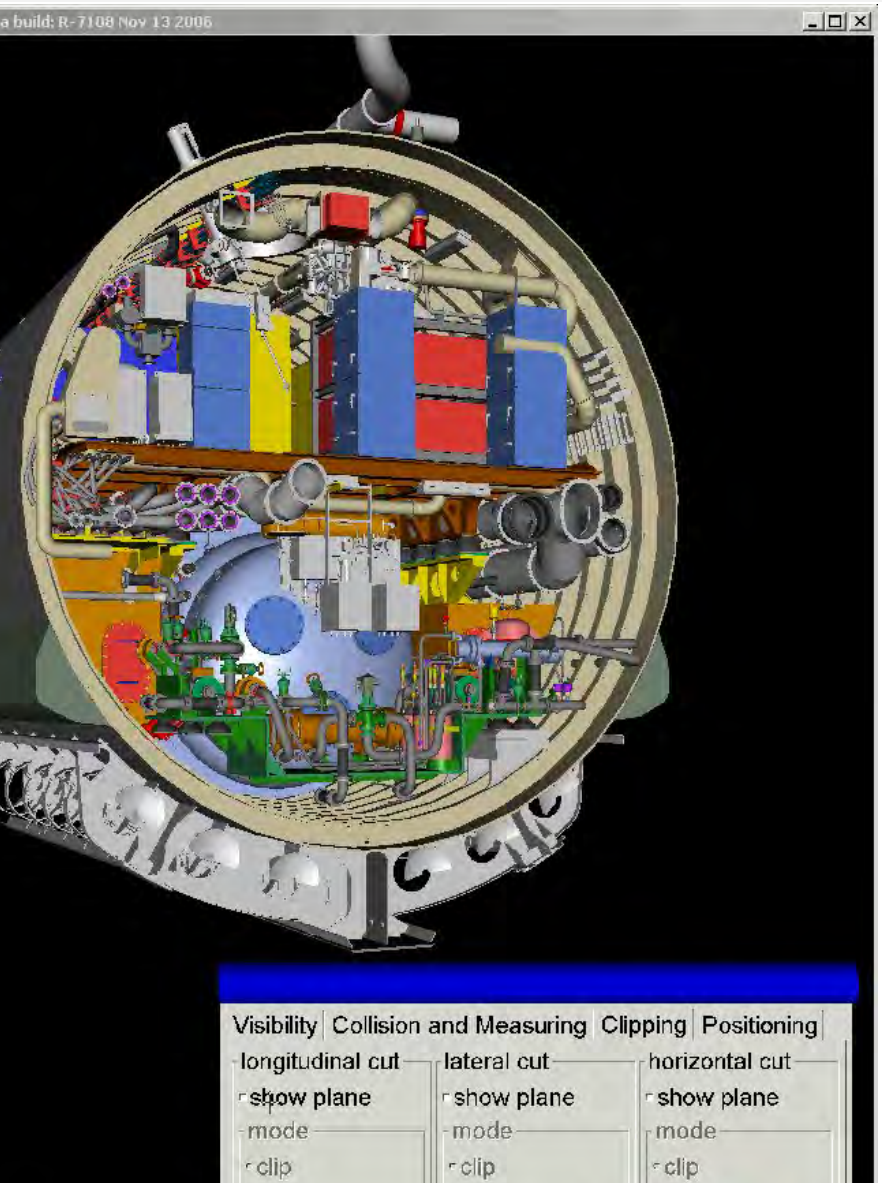
- Procedural Shapes
  - Generative Modelling Language (GML)
  - Semantic Modelling
- Terrain-Rendering
- High-level Avatar Controller
- Object-to-Object collision detection
- Mesh based simulator
  - (e.g. MassSpring, CantileverBeam, ...)
- Force-Field Evaluator
- Steering System
- Programmable Particle System

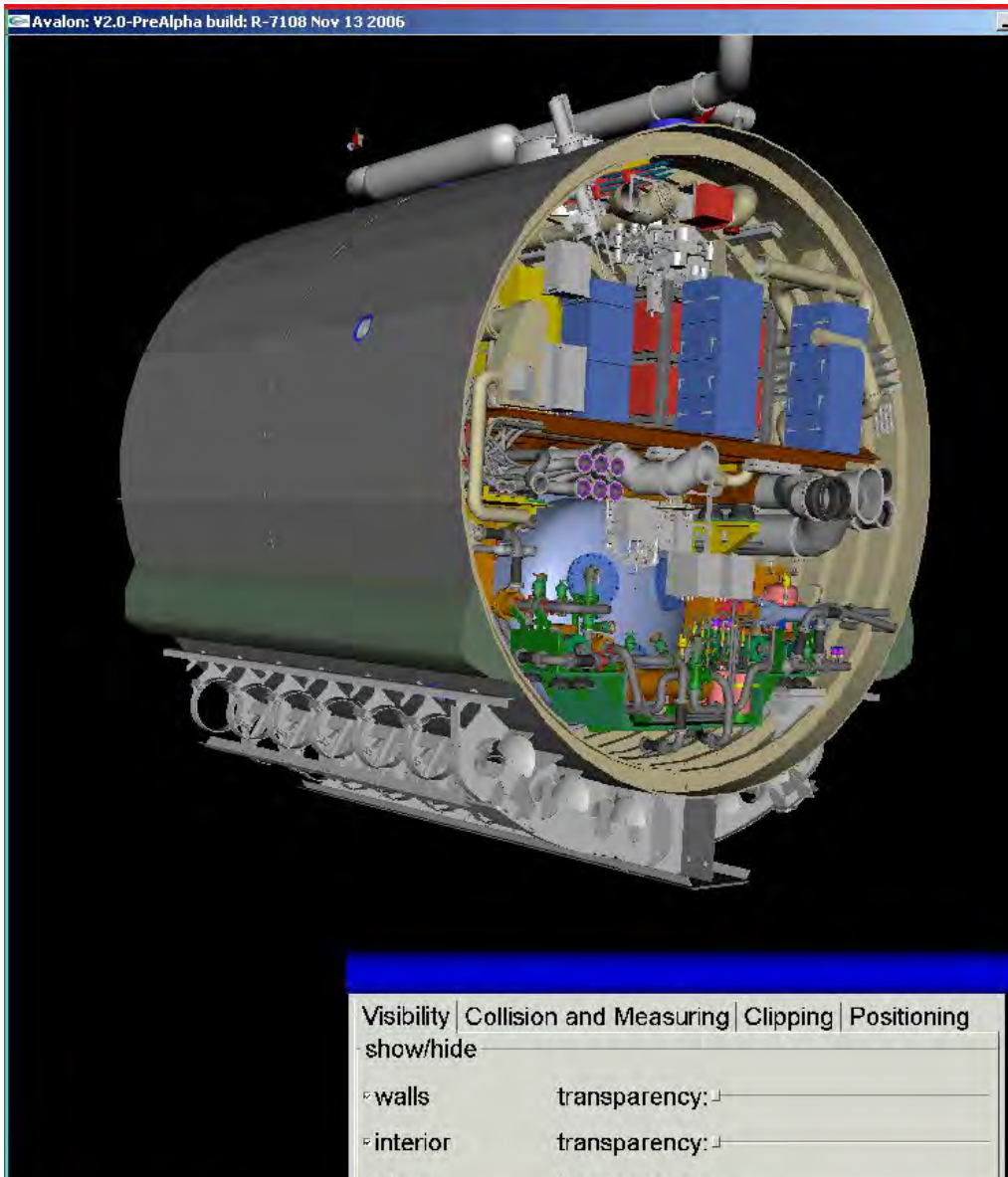


Application example

Design Review

HDW



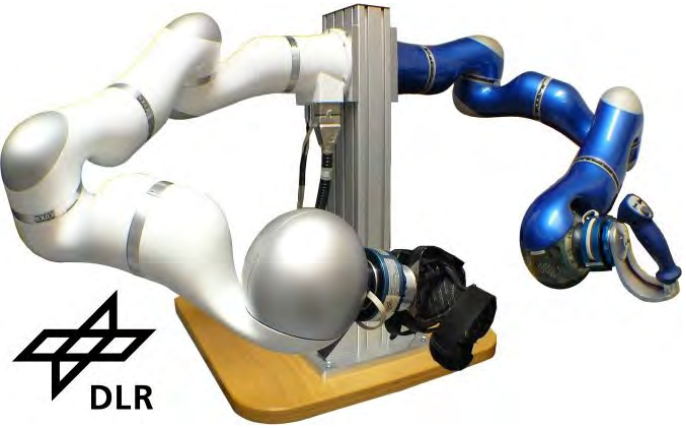


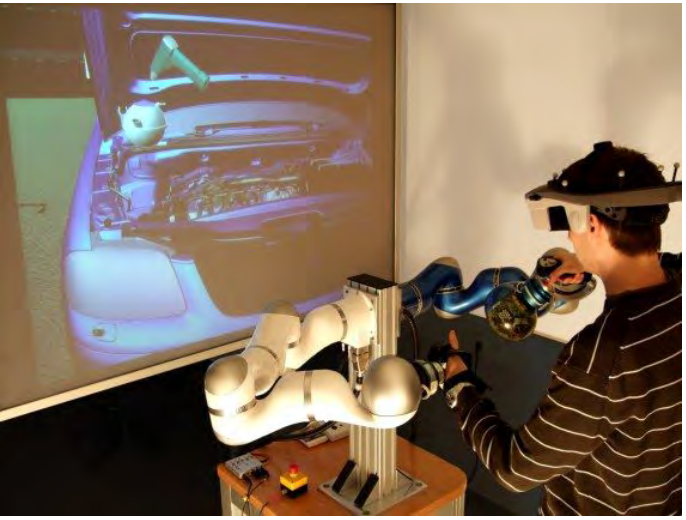
Design Reviews

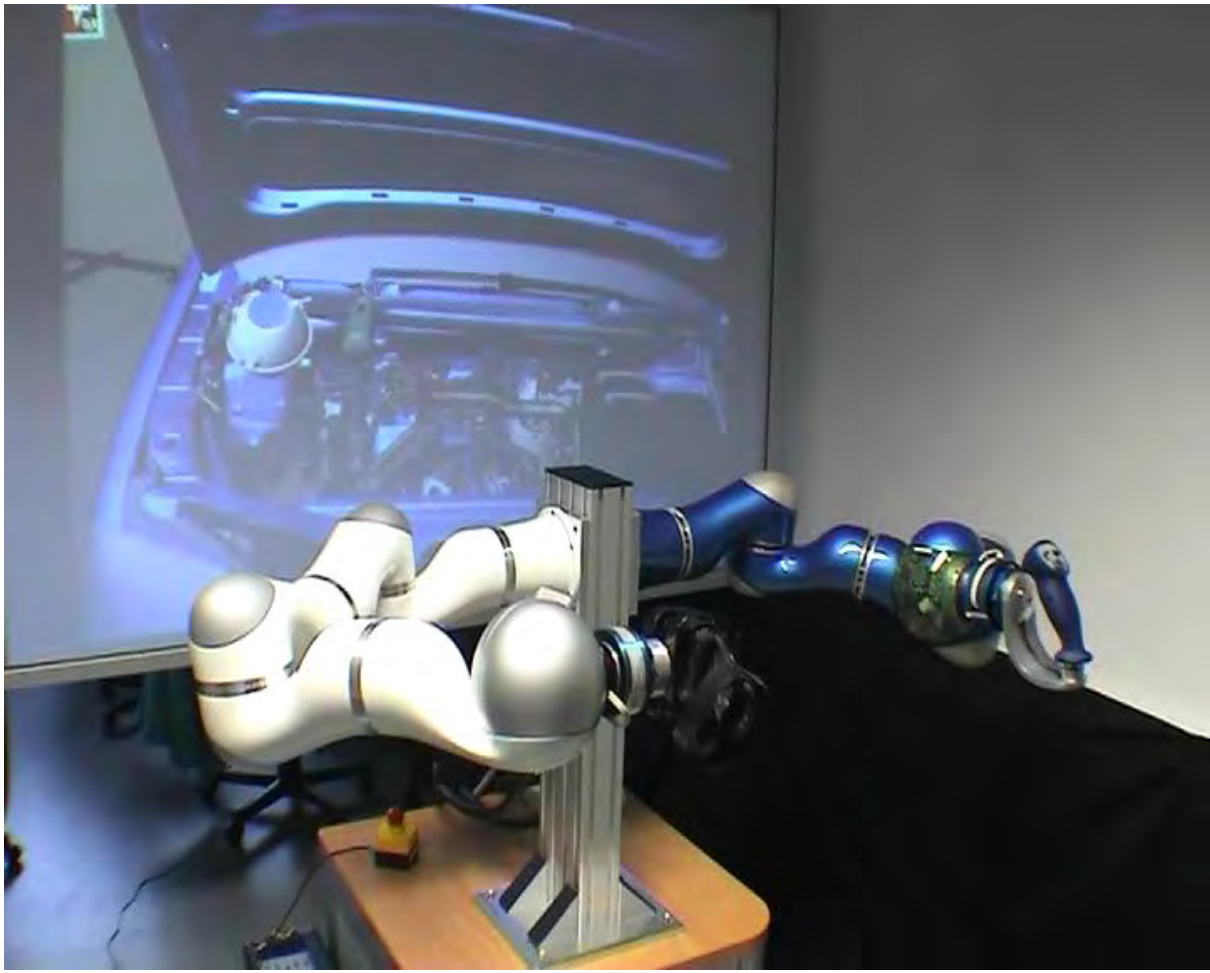
VW

Assembly and Disassembly

DLR

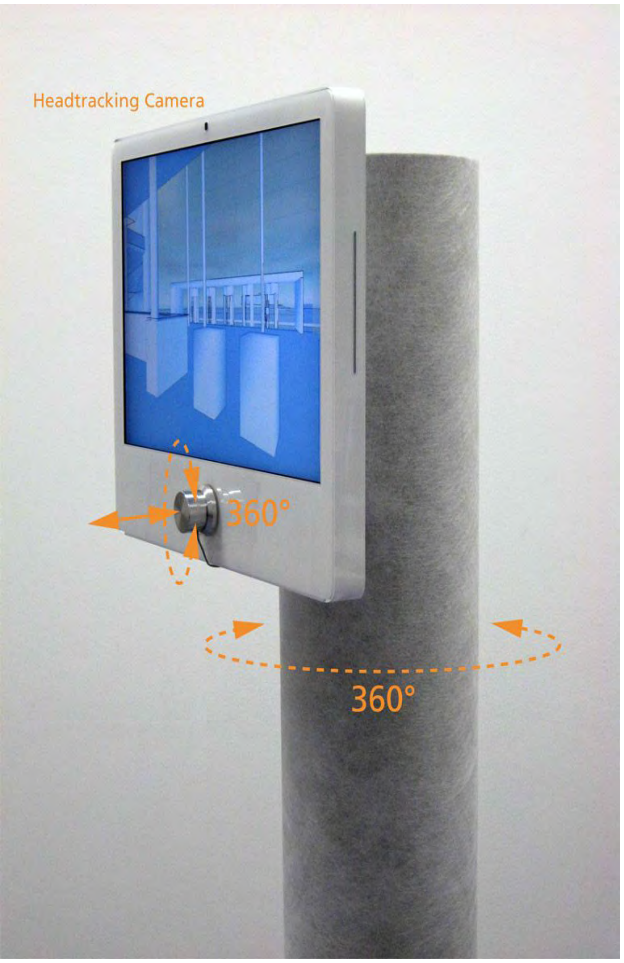


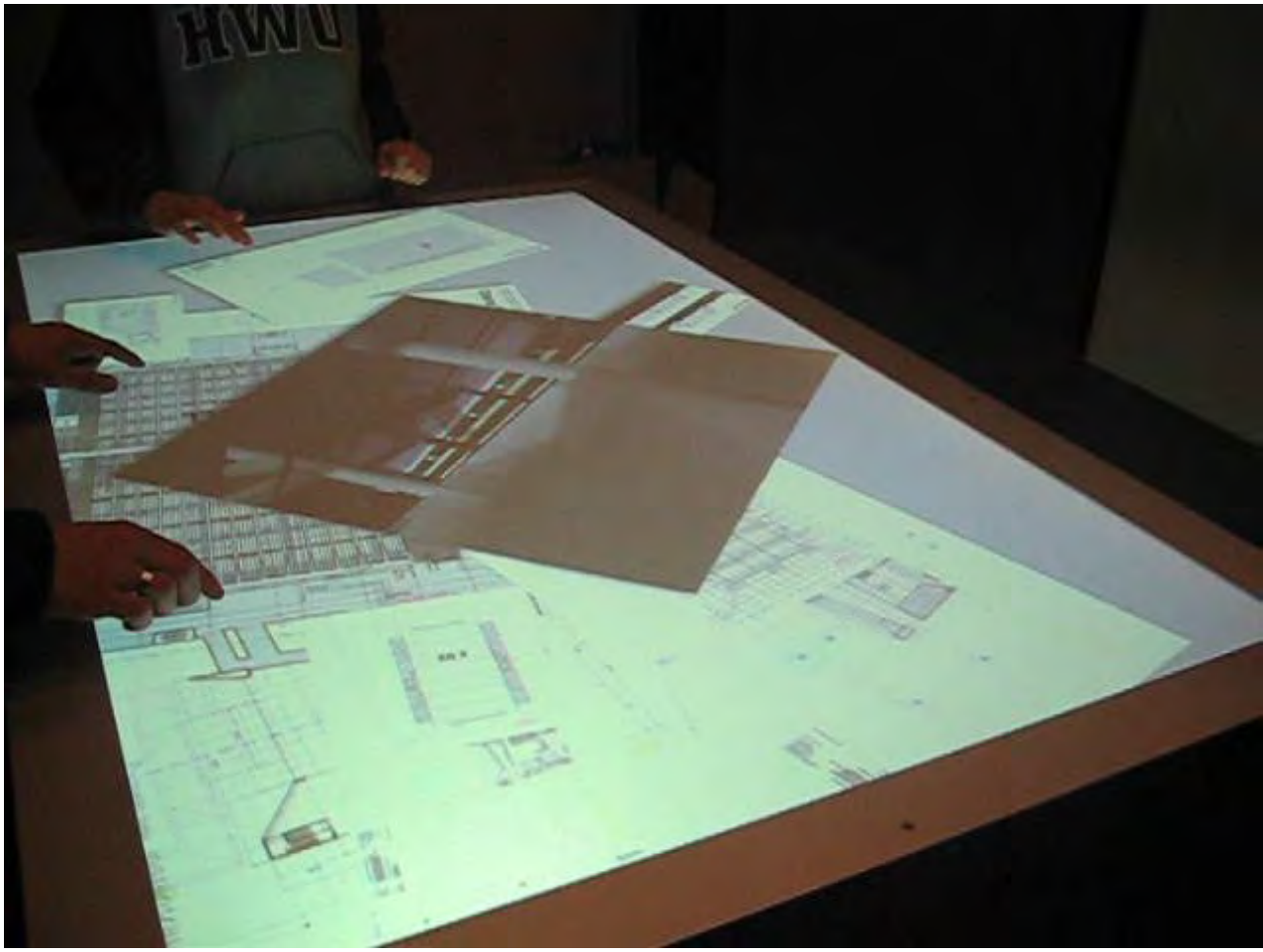




Architecture Walkthrough

Messe Frankfurt





TouchLab

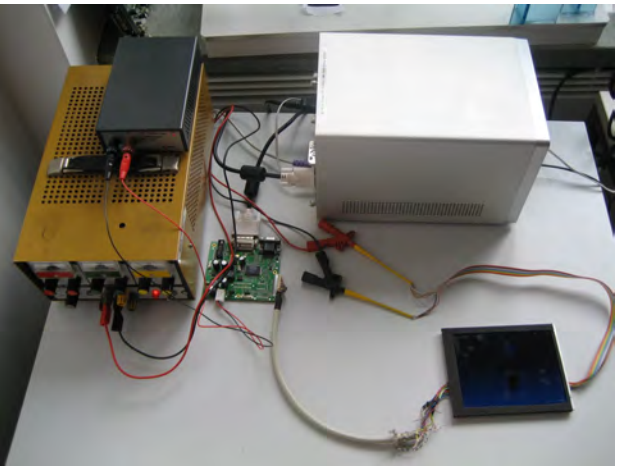
EADS / NMY

HEyeWall (35x MegaPixel wall)

Fraunhofer ZV

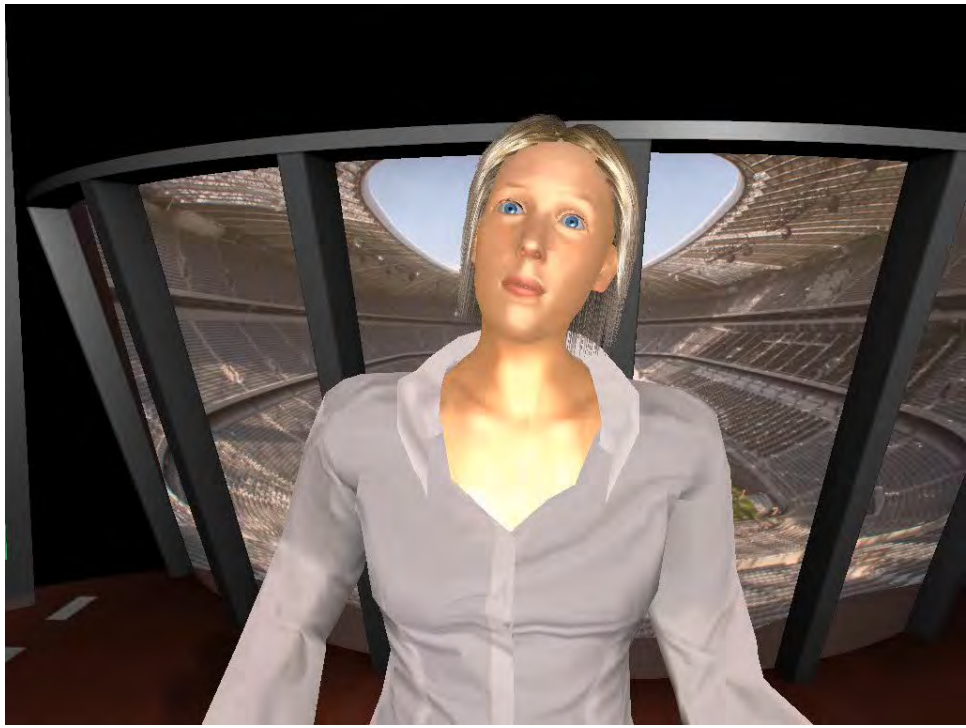
Virtual Car Assistant

Volkswagen AG



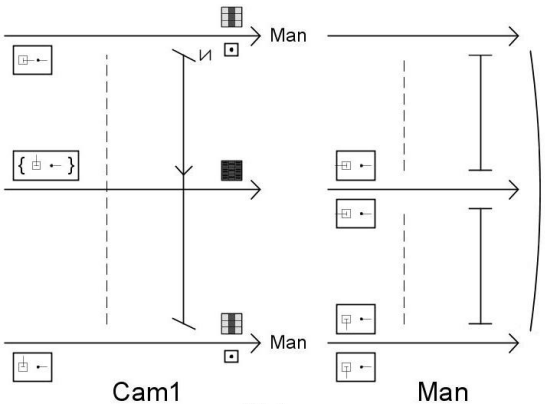
Virtual Human

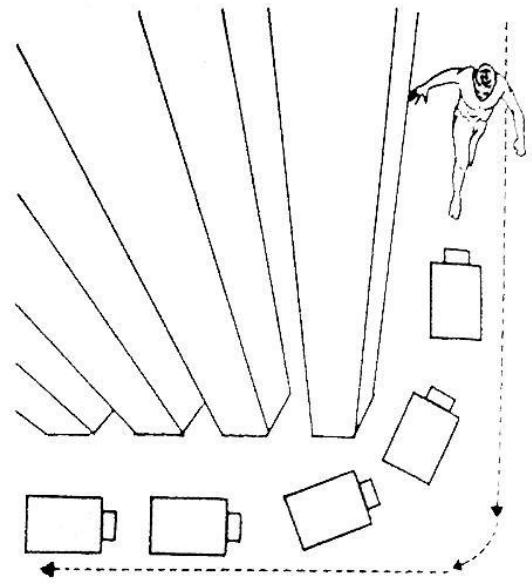
BMBF



Answer

EU Project



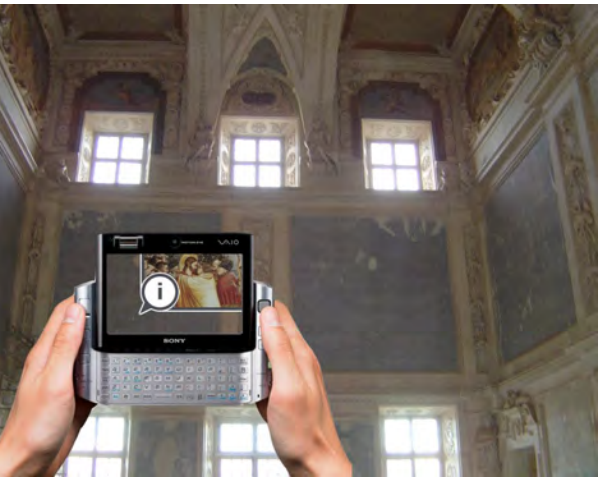


Alignment of CAD/Real-Prototypes

Howaldtswerke - Deutsche Werft GmbH

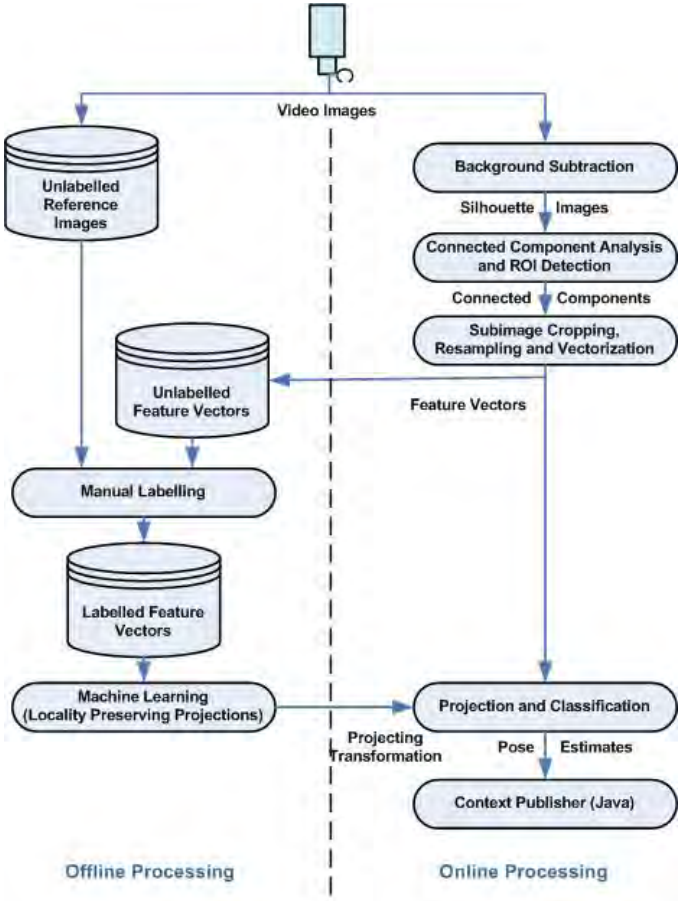
Cultural Information System

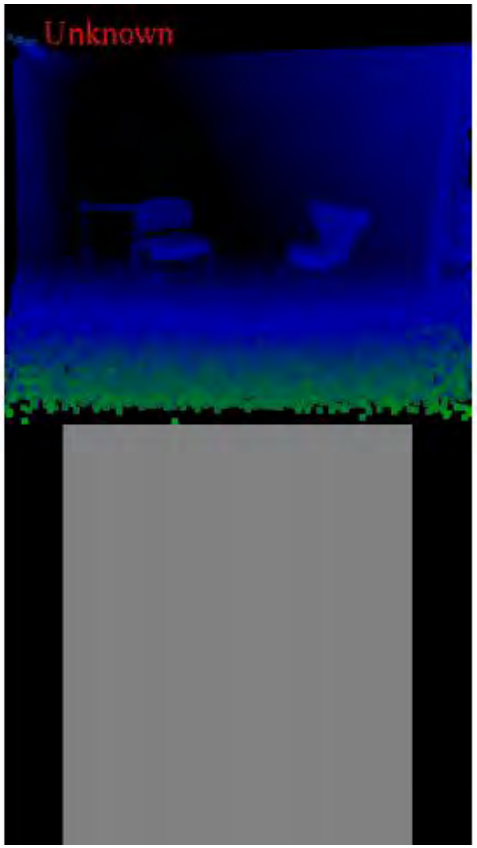
iTacitus, EU

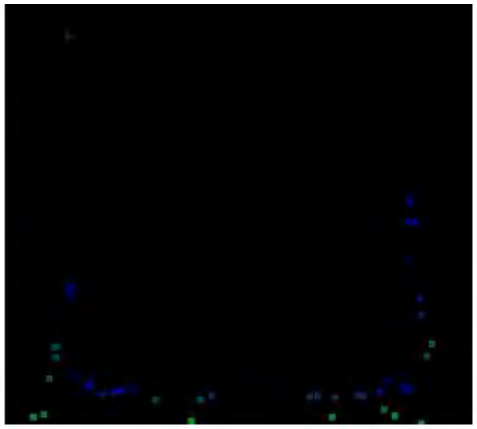


Human Posture Recognition

Persona: EU

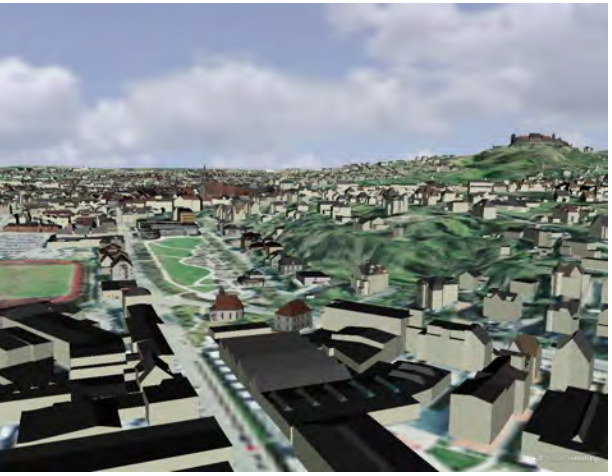






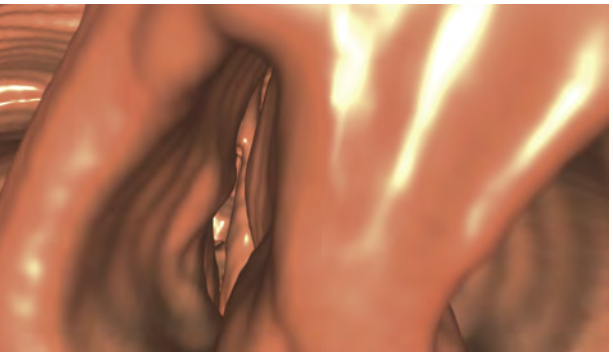
Geo Information System

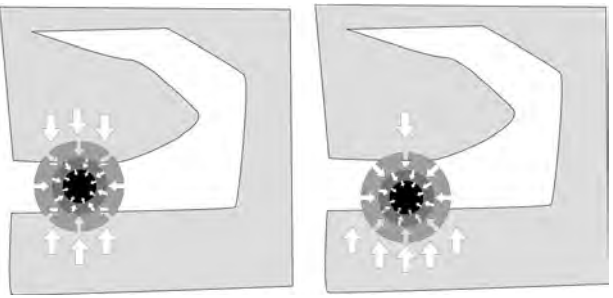
Coburg IFP

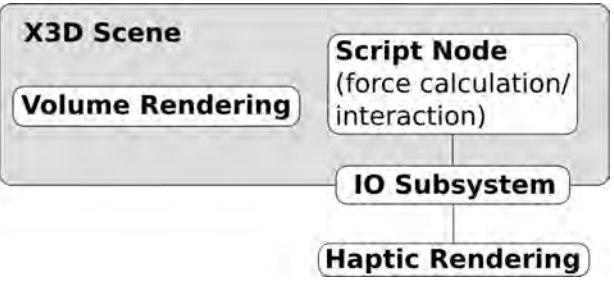


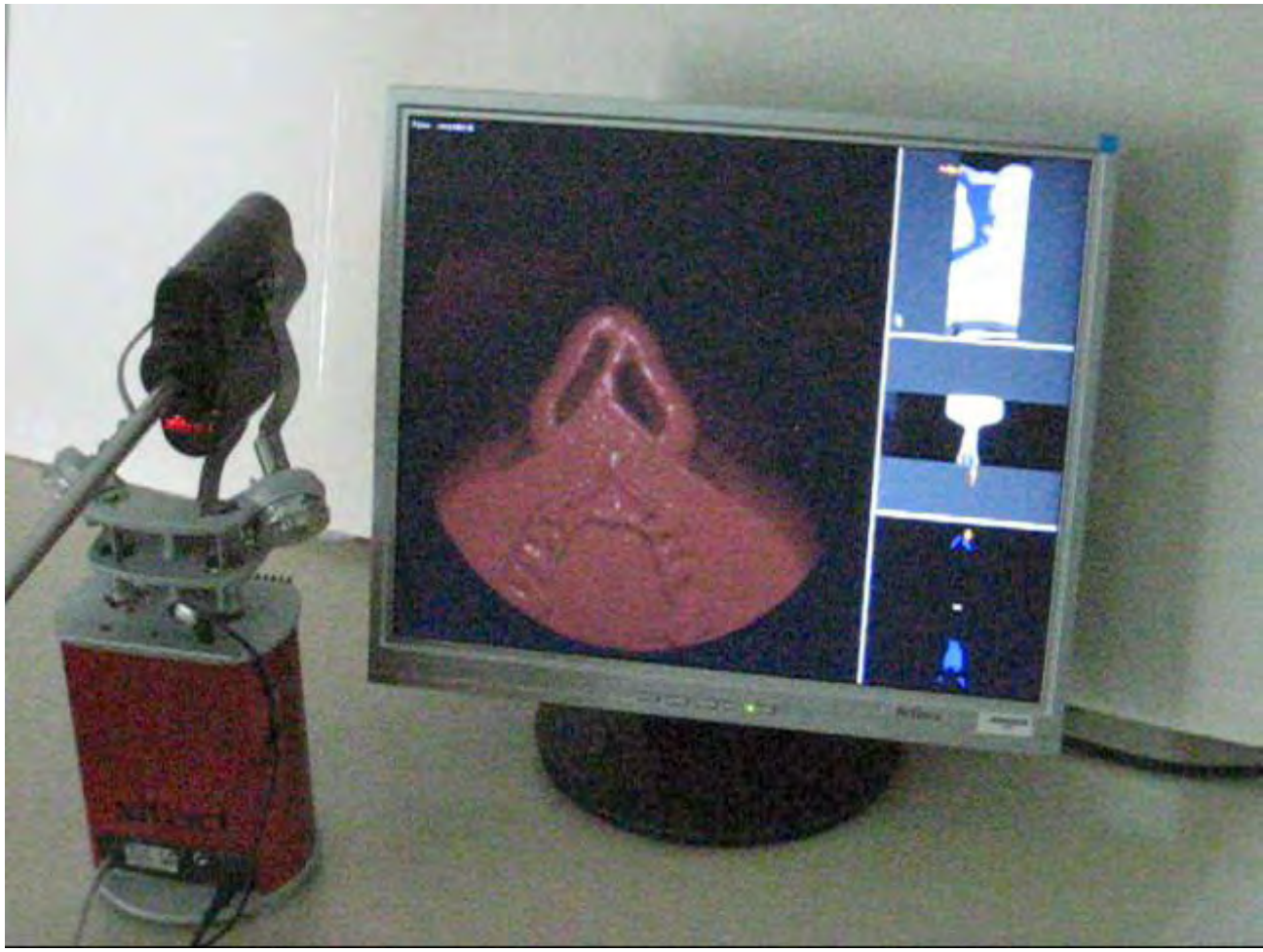
Medical Training-simulator

VIVERA, BMBF



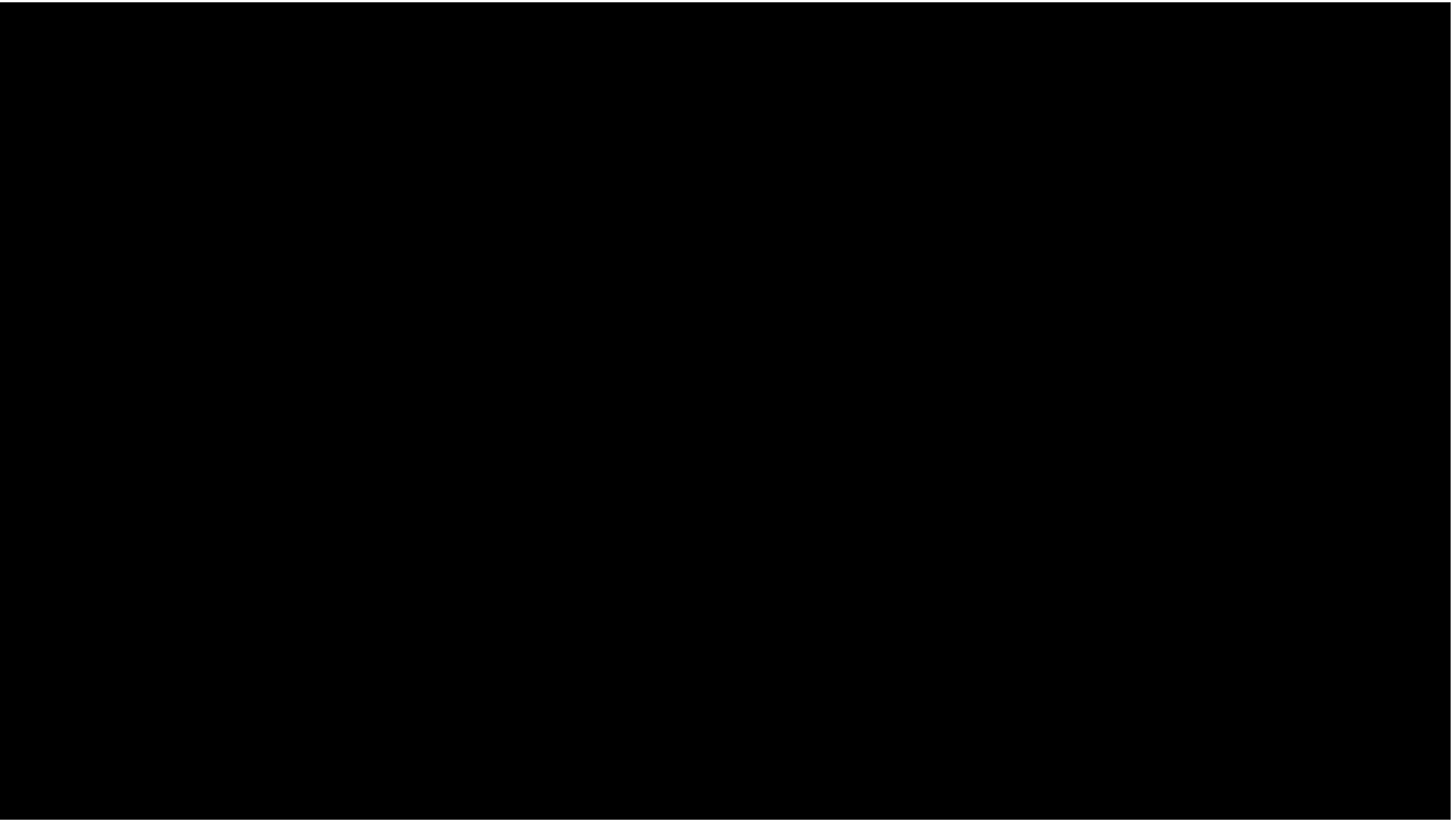




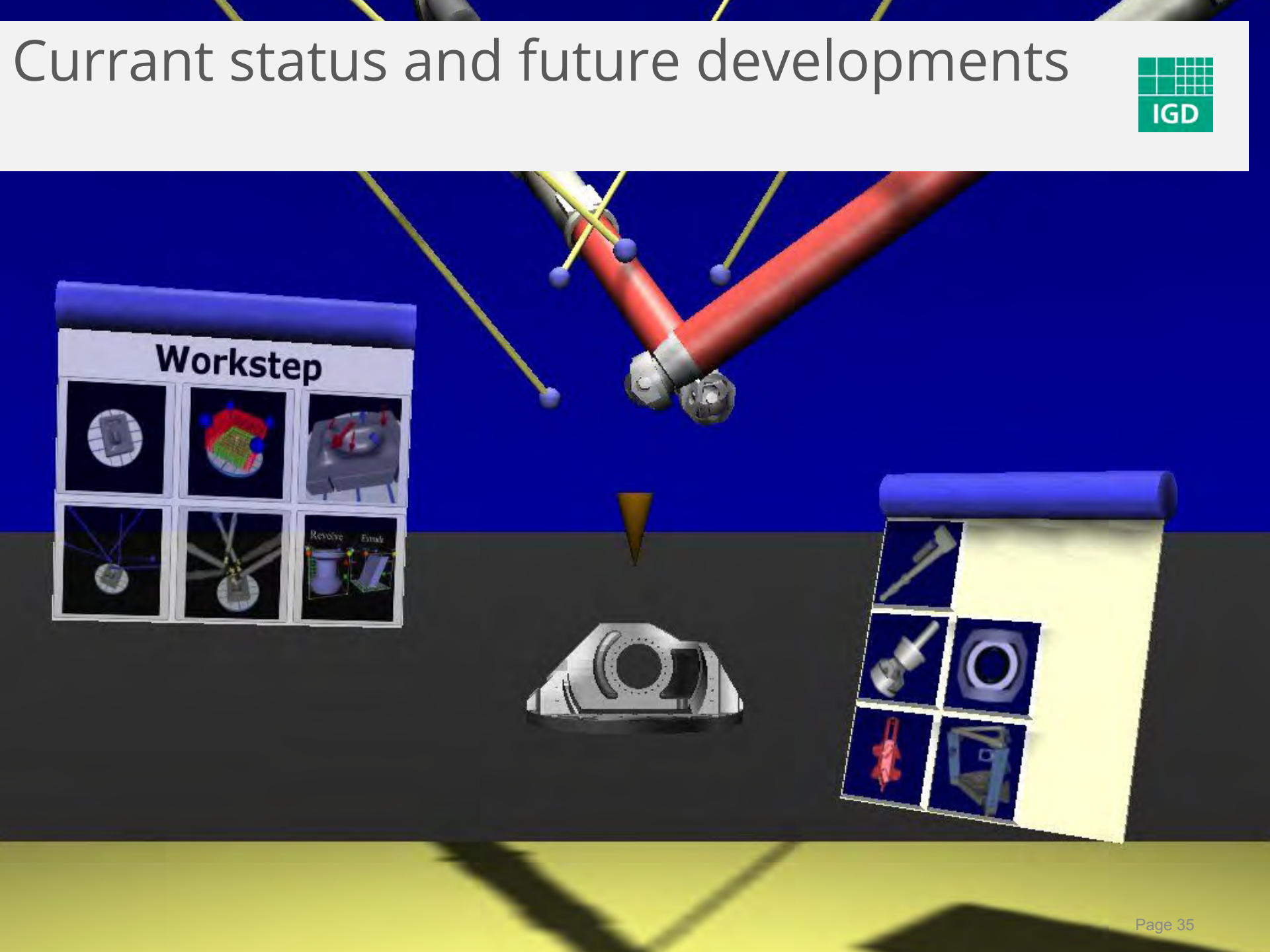


Service Control Center

SAP AG

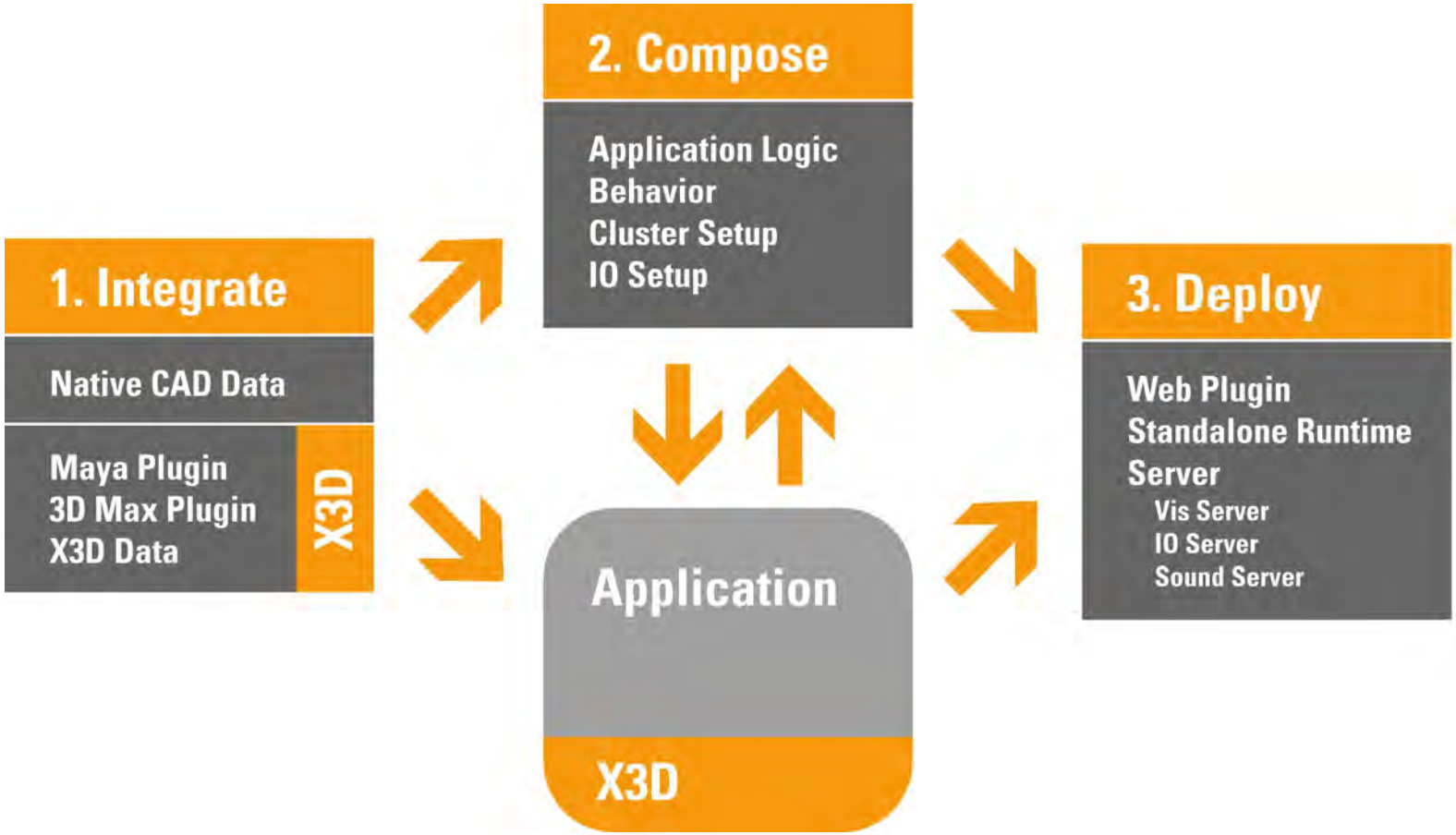


Currant status and future developments



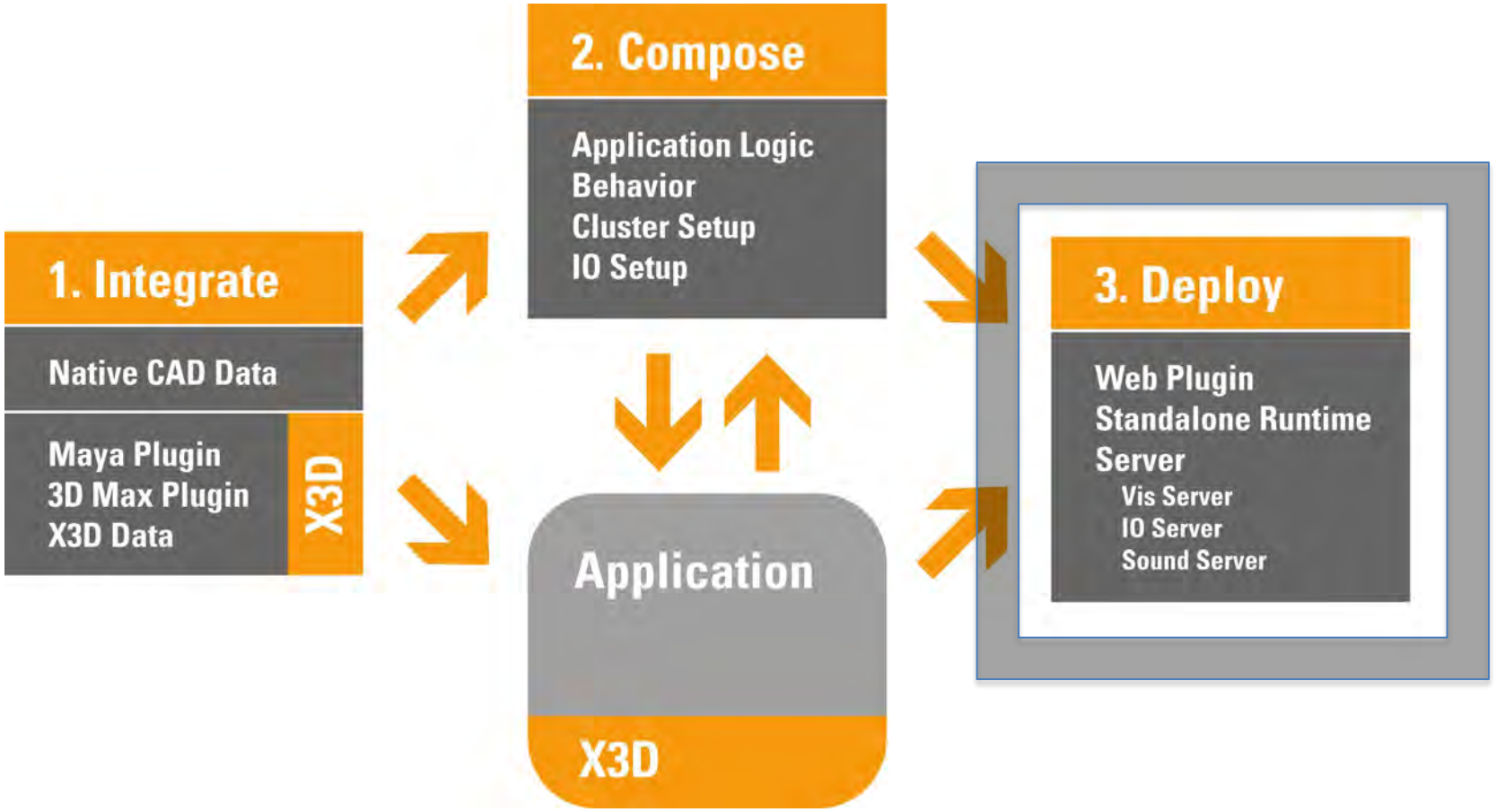
instantReality Framework

Development and Runtime-environment



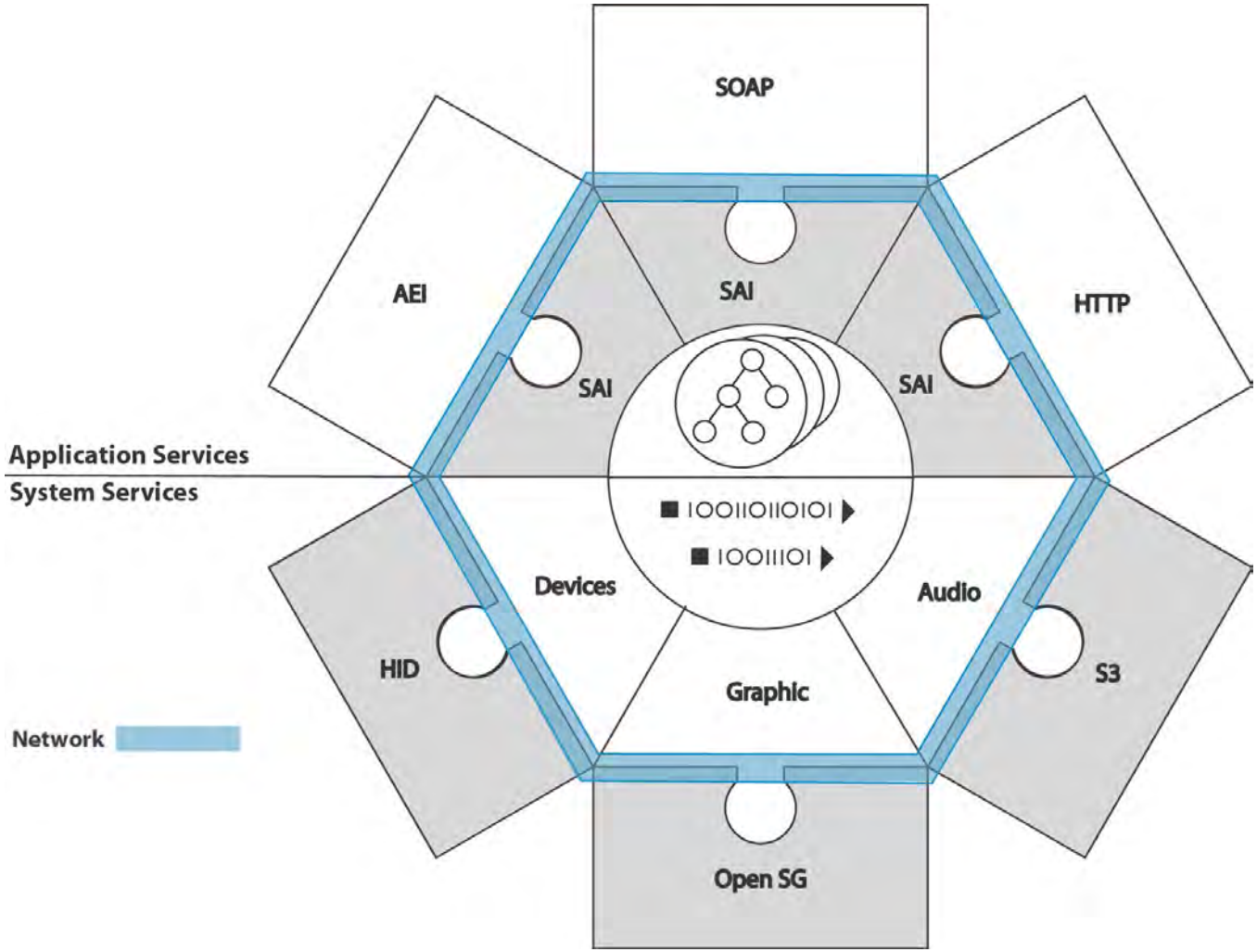
instantReality Framework

Development and Runtime-environment



instantReality Player

Network services



Standard Conformance

- X3D (ISO/IEC 19775:2004)
- GLSL (Khronos Group)
- CG (NVIDIA Corporation)
- OpenGL 2.0 (Khronos Group)
- ECMAScript (ISO/IEC 16262:2002)
- JAVA (Sun Corporation)
- SOAP (W3D SOAP V1.2)
- ZEROCONF (IETF Zeroconf Working Group)

Plattformunabhängigkeit

OpenSG/GL CodeBase: Win32, Unix/Linux, OSX

OpenGL/ES CodeBase: Windows CE, iPhone

instantReality Player

Public released

Free Version for non-commercial use

- Beta0; 15 April 2007; First Test Release
- Beta1; 15. June 2007; All OS-Release
- Beta2; 15. July 2007; Web3D SDK Release
- Beta3; 27. December 2007; X-Mas Release
- Beta4; 15. April 2008; Cluster Release
- Beta5; 7. August 2008; IO-SDK Release
- Beta6; 15. March 2009: IEEEVR Release
- Beta7; 23. December 2009; X-Max Release

- First 2.0 15. January 2010

instantReality.org Webpage

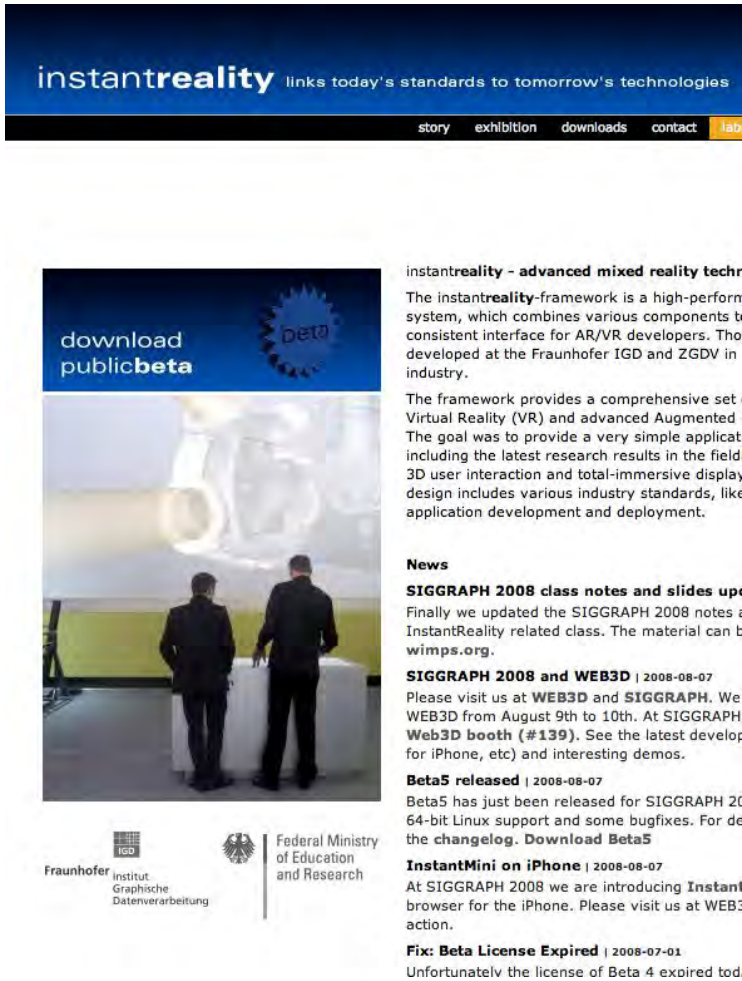
Portal for internal and external user

Front Pages

- News
- Project Exhibition
- Info & History
- Release-plan

Developer Pages

- Node/Component Documentation
- Tutorials
- IO-System Documentation
- EAI-System Documentation
- Forum (~200 User)



instantReality User

Project partner from IGD/A4

- IGD-Intern (CAMTECH, A1, A2, A3, A5, A7)
- Fraunhofer-Intern (IAO, IFF)
- > 20 Industrial Projects
- > 10 BMBF Projects
- > 20 EU Projects

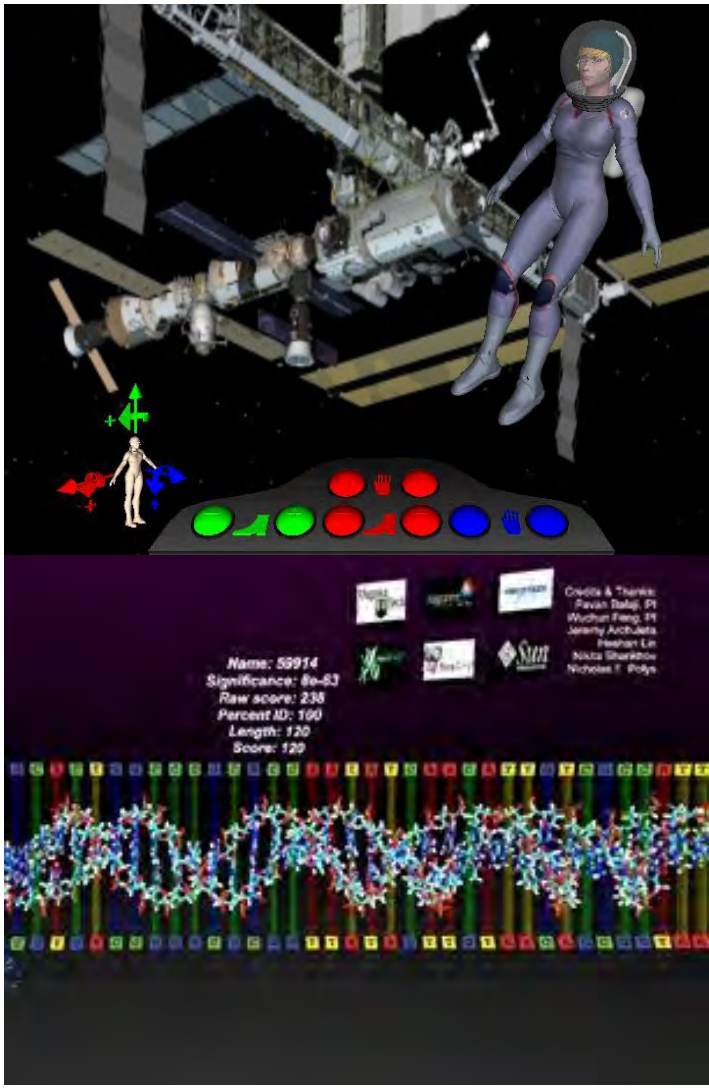
instantReality User

Research and Development

- > 5 Fraunhofer Groups
- > 5 Universities in Europa
- MIT (Dep. of Aeronautics and Astronautics)
- Virginia Tech

Industry

- VW
- Daimler
- SAP
- HDW
- DLR
- ...



instantReality for teaching

VR/AR Lectures

- TU Darmstadt
- TU Claustahl
- University College London
- TU Chemnitz
- Uni bielefeld

Tutorials and Classes

- Web3D 08: VR/AR Tutorial
- Siggraph 08: Don’t be a WIMP
- IEEE VR 09: VR/AR Tutorial

Don't be a WIMP: A 60-Second Introduction to Augmented and Virtual Reality

SIGGRAPH 2008 Class

Wednesday
8:30 am - 10:15 pm
Room 502 A
Level: Beginning

Johannes Behr
Fraunhofer Institut für Graphische Datenverarbeitung

Dirk Reiners
University of Louisiana at Lafayette

Abstract

Virtual and augmented reality have been around for a long time, but for most people they are movie fantasies. Very few people outside a few research labs have worked with or experienced these systems. On the other hand, interactive 3D graphics is ubiquitous, mostly in the form of games. More and more people are working in animation and games, creating models and programs for interactive 3D applications on standard monitors.

The goal of this class is to demonstrate that the leap to actual immersive or augmented environments is not as big as you might think. It explains how high-powered 3D graphics cards, mainstream applications of stereoscopic displays in 3D TV and movies, and webcams that achieve TV-quality images have significantly lowered the barriers to entry. And how, in combination with those hardware advances, freely available software based on open standards like X3D provides all the tools you need to access the elusive world of virtual and augmented reality applications. Following a summary of the basic principles of stereo displays, tracking systems and post-WIMP interaction metaphors, the main part of the course is a practical introduction to creating and running your own interactive and immersive applications.

Prerequisites

Basic knowledge of computer graphics. Understanding of what polygons, lights, and cameras are. Helpful but not required: graphics programming or 3D animation experience. This class is intended for attendees who are interested in interactive 3D graphics and might want to move beyond the WIMP (Window, Icon, Menu, Pointer) environment.

Instructors Information

Johannes Behr

Johannes Behr leads the VR group at the Fraunhofer Institut für Graphische Datenverarbeitung in Darmstadt, Germany. His areas of interest focus on virtual reality, computer graphics and 3D interaction techniques. Most of the results of his recent work are available as part of the InstantReality Framework. He has an MS from the University of Wolverhampton and received his PhD from the Technische Universität Darmstadt.

Dirk Reiners

Dirk Reiners is a faculty member in computer science at the University of Louisiana at Lafayette. His

instantReality Standardisation

IGD part of the WEB3D-Consortium since 2007

Member of „Workinggroups“

- General (Extensions & ISO)
- HAnim (Humanoid Animation)
- Medical (Volume Rendering)

One Member in BOD

Web3D Symposiums

- Sponsored by ACM
- 2008: Los Angeles, CA
  - Prof. Fellner: Paper-Chair
- 2009: Darmstadt

  www.web3d2009.org
  - Prof. Fellner: General Chair
  - Johannes Behr: Paper Chair

instantReality Future developments

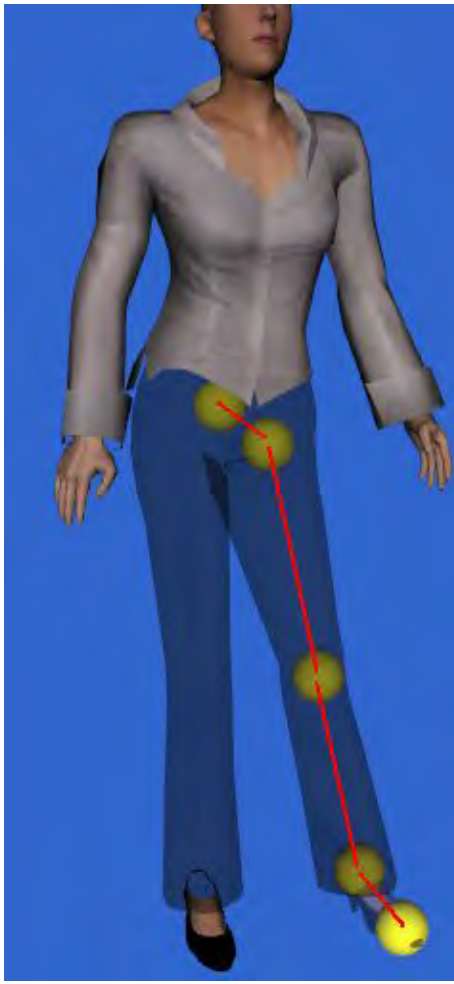
Visualisation

- Dynamic Optimisation (BIH)
- Huge Model (out-of-core)
- Server-side retrieval (GEO/GIS)

Distributed Multi-User Systems

Character Animation

Parametric Systems



Fraunhofer IGD

instant**Reality** and OpenSG resources

www.instantreality.org

- Beta6 release
- 30+ Device Handler
- Distributed Rendering/IO
- IO-SDK
- Windows/Mac/Linux

www.opensg.org

- LGPL source
- Rendering