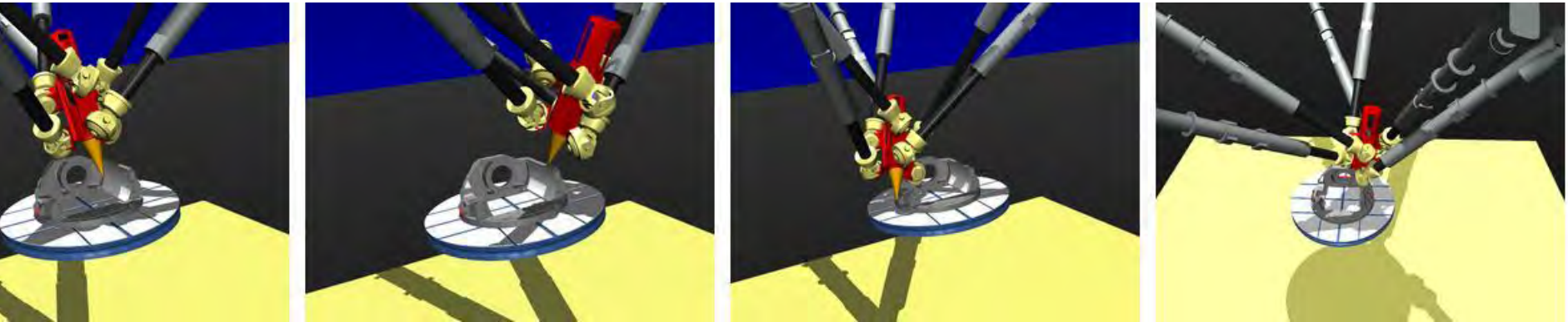


instantReality

Framework for AR and VR application



Johannes Behr

Fraunhofer IGD – A4

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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





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

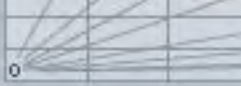
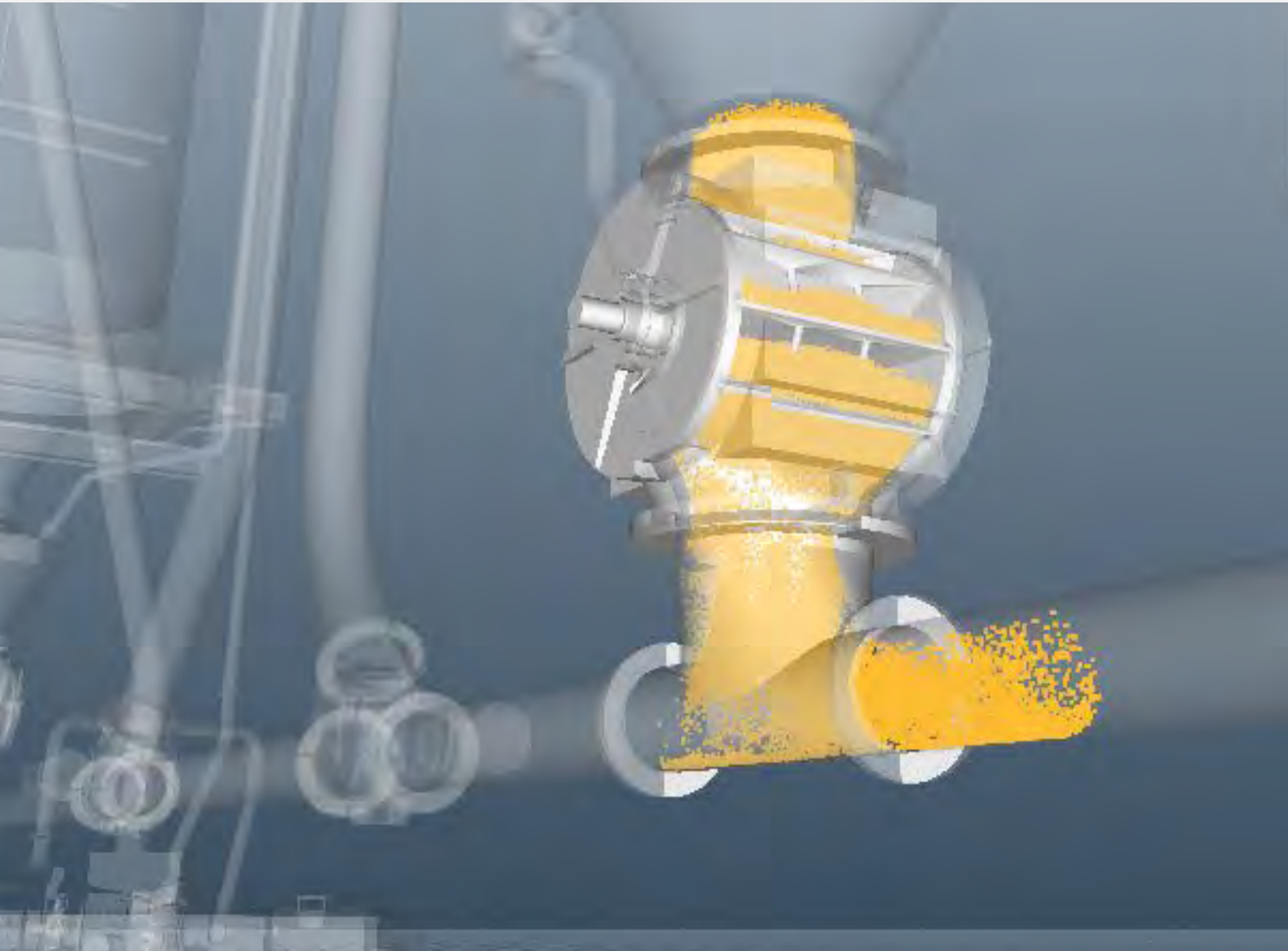
2000 OpenSG (LGPL Scene Graph)

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



Performance
PE/PP Pellet with b
and particle size 3

Requirements for the 3rd gen system



Problem: Wide variety of topics and feature-requests

Distributed Systems

Multi-Core/GPU

Indoor-AR

Outdoor-AR

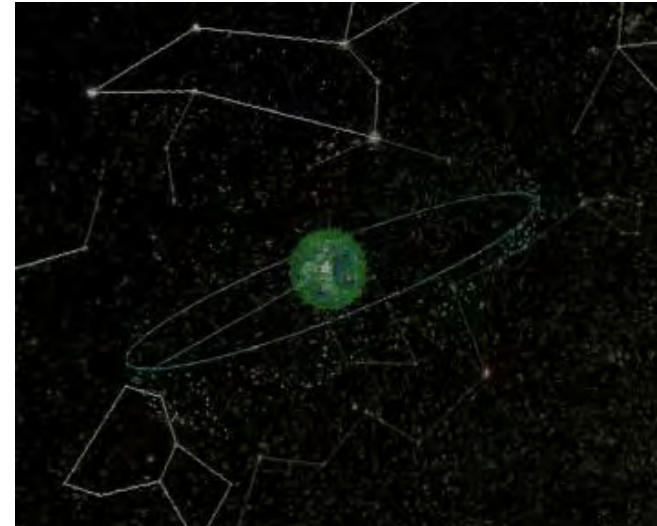
Multi-Sensor net.

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

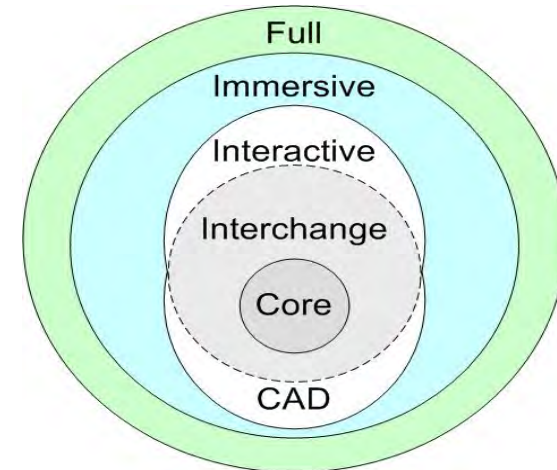
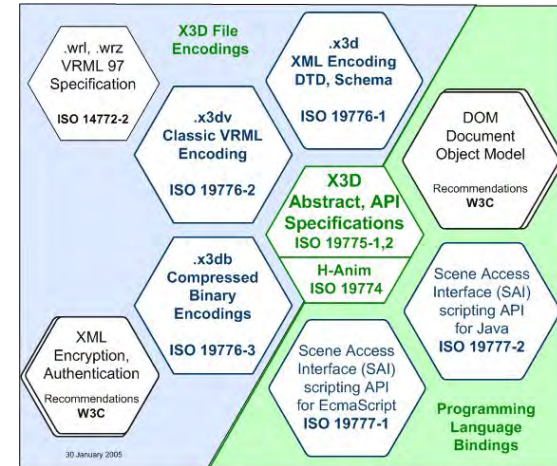


There is no standard for VR/AR Application dev

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



File Edit View Extras Engine Window Help

Route editor

```

graph TD
    Timer --> LeftArm_OI
    LeftArm_OI --> LeftArm_I
    LeftArm_I --> RightArm_O
    RightArm_O --> RightArm_I
  
```

OpenSG render backend
 21.277 Draw FPS
 0.047 TravTime
 0.047 DrawTime
 42 Nodes culled
 10 Nodes culled
 11 material changes
 10 matrix changes
 12 Nodes drawn
 3 transparent Nodes drawn
 25627 triangles drawn
 1 lines drawn
 0 points drawn
 52905 vertices transformed
 9 textures used
 74273536 bytes of texture used

Appearance editor

Material Texture Tex. trans. Shader

Name Type
 TheShader ComposedShader

96276400:vertex 96276984:fragment

Code node: 96276400

Fields:

Fieldname	Fieldvalue	Datatype
b	0.58	SFFloat
g	0.82	SFFloat
height	512	SFInt32
width	512	SFInt32
crvIntensiv	0.835619	SFFloat

Code [inlined]:

```

varying vec3 lightvec;
varying vec3 halfvec;
varying vec3 lightvec2;
varying vec3 halfvec2;
varying vec3 camVec;
varying vec3 normal;
varying vec3 eye;

void main()
{
  gl_TexCoord[0] = gl_MultiTexCoord0;

  vec4 lightnEyeSpace = vec4
  (gl_LightSource[0].position.xyz,1.);
  vec3 lightnObjSpace =
  (gl_ModelViewMatr.inverse *
  lightnEyeSpace).xyz;

  vec4 lightnEyeSpace2 = vec4
  (gl_LightSource[1].position.xyz,1.);
  vec3 lightnObjSpace2 =
  (gl_ModelViewMatr.inverse *
  lightnEyeSpace2).xyz;

  vec4 eyeVecInEyeSpace = vec4(0., 0., 0., 1.);
  vec3 eyeVecInObjSpace =
  (gl_ModelViewMatr.inverse *
  eyeVecInEyeSpace).xyz;

  normal = gl_Normal;
  
```

zoom: 0.9, nodes: 4, fps: inf, mouse: 146, 178

TreeView

Context root: Scene

Type	Name
Scene	scene
Background	95148952
NavigationInfo	95153456
PerspectiveViewpoint	view0
ComponentTransform	LICHT
KeySensor	keySensor
ValueTrigger	trigger0
ValueTrigger	trigger1
ValueTrigger	trigger2
ValueTrigger	trigger3
ValueTrigger	trigger4
ValueTrigger	trigger5
ValueTrigger	trigger6
ComponentTransform	Lebacher-Transform
Foreground	96559968
ComponentTransform	MENU
Script	script
TimeSensor	Timer
TimeSensor	TSens
OrientationInterpol...	LeftArm_OI
OrientationInterpol...	RightArm_OI

avalon

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



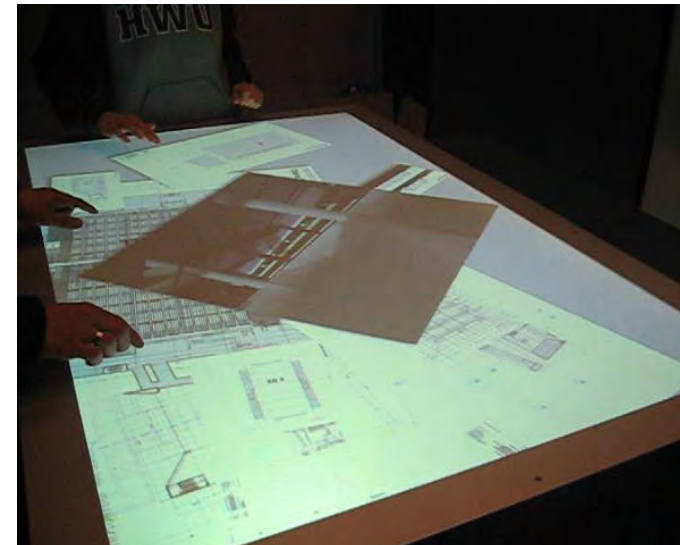
High-Level: Virtual Object Sensors

- Device and Device-class independent
- Extends 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)

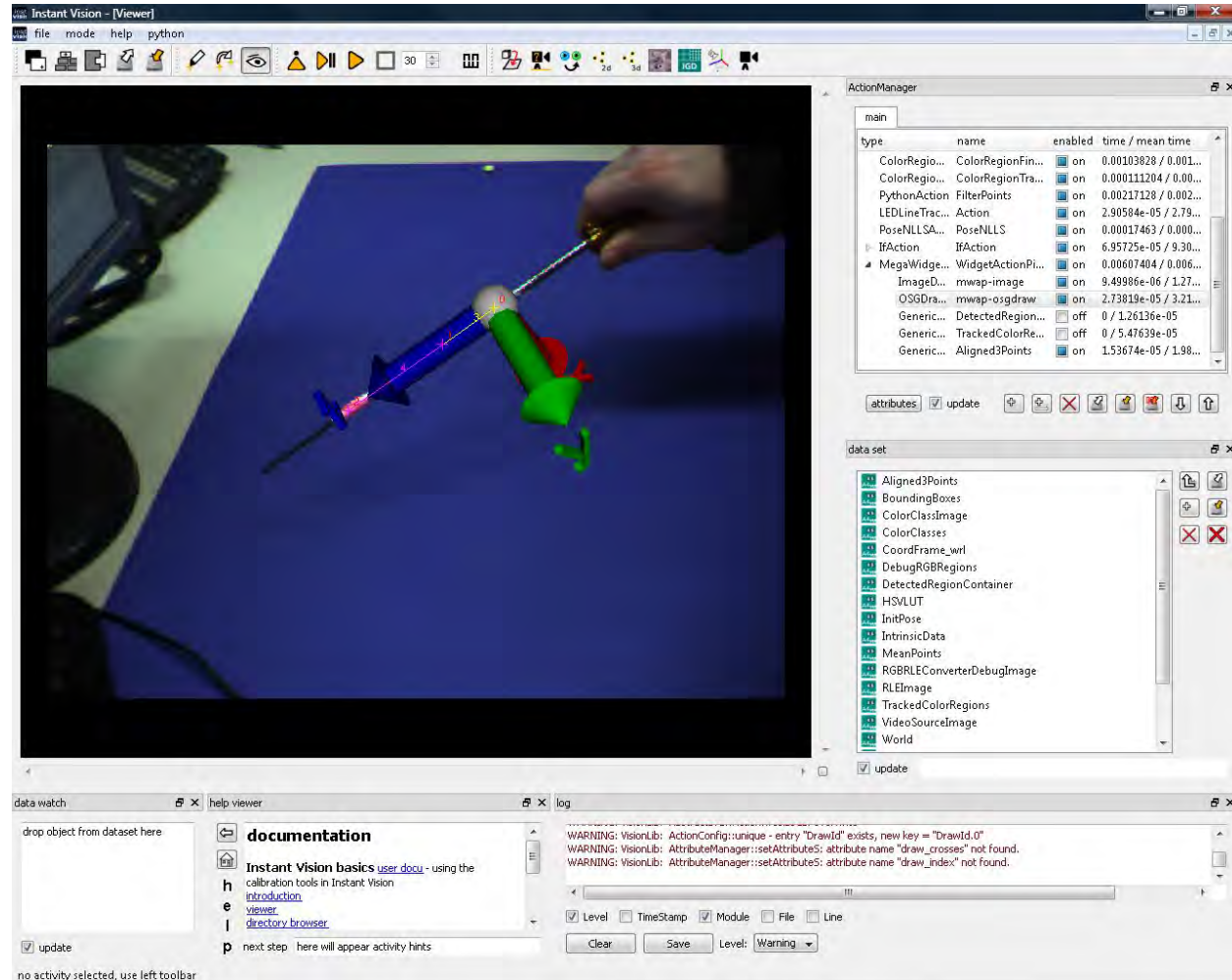


System-feature and architecture

instantVision: Vision based tracking

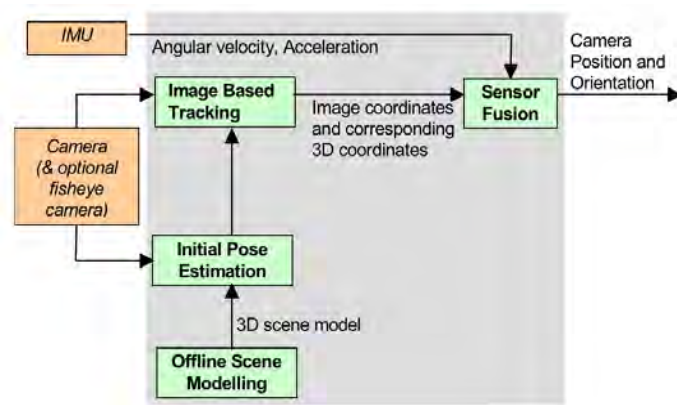


Subsystem for
Vision-based tracker
InstantVision:
composing, testing
and tuning of visual
tracking pipeline
Support for marker,
poster and different
natural-feature
tracker (e.g.
line-tracker, KLT)



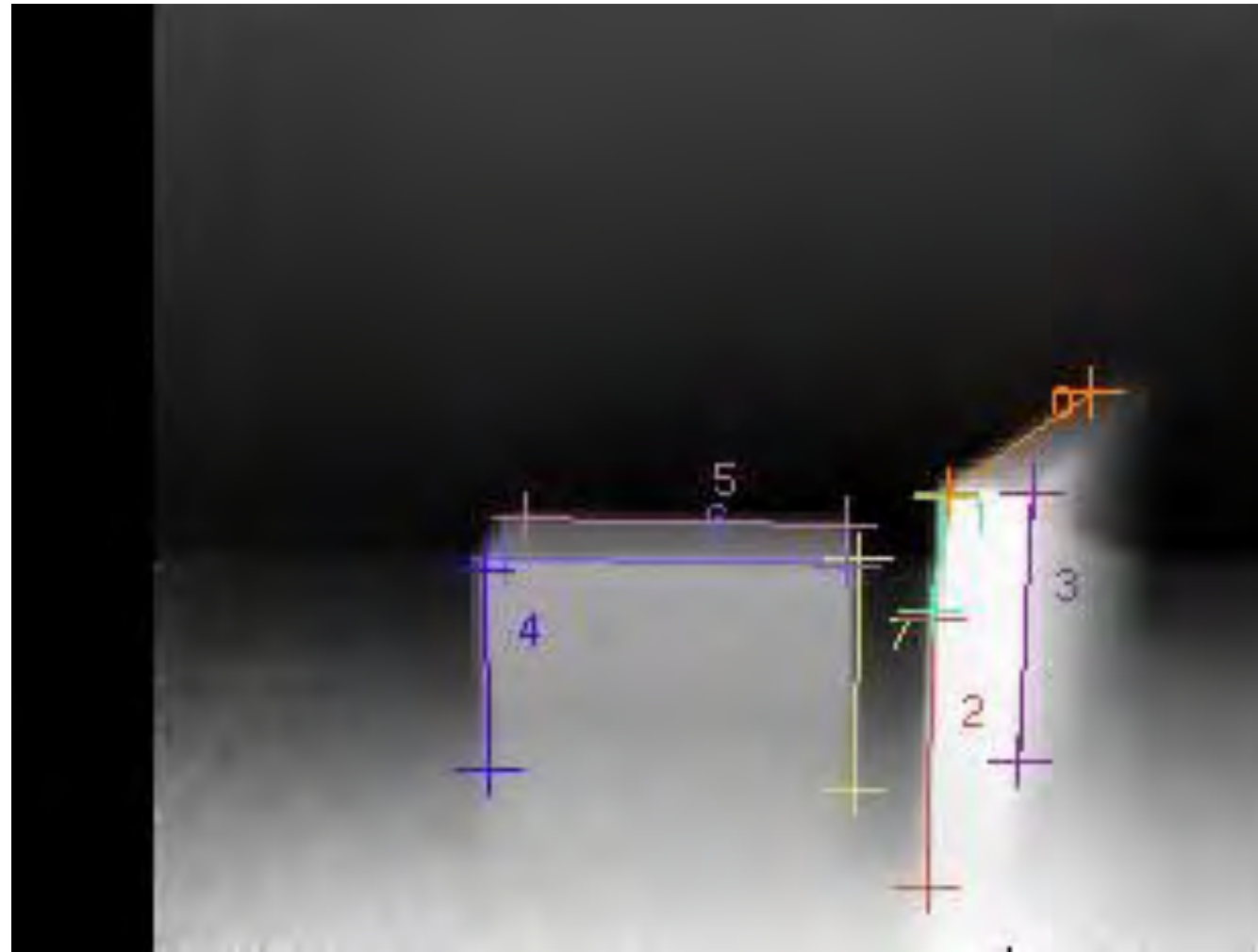
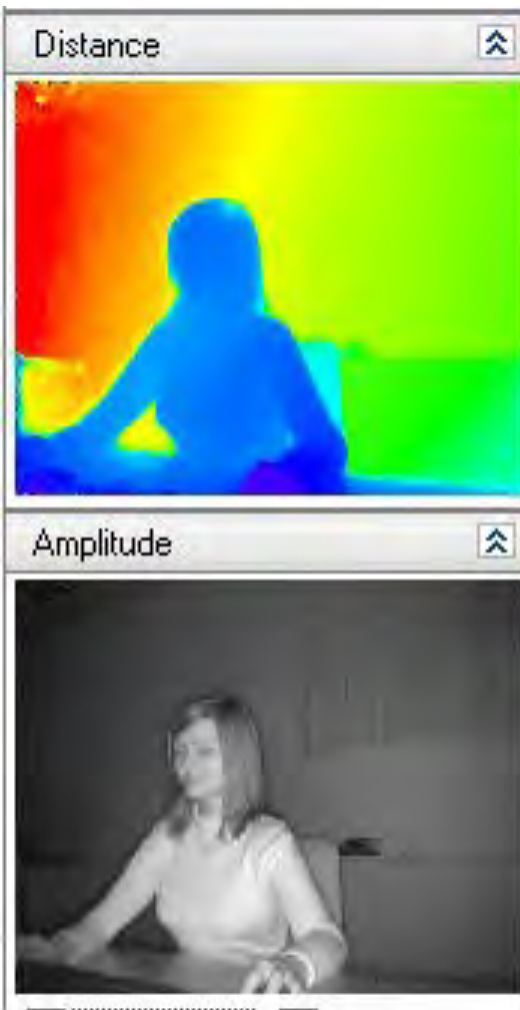
System-feature and architecture

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

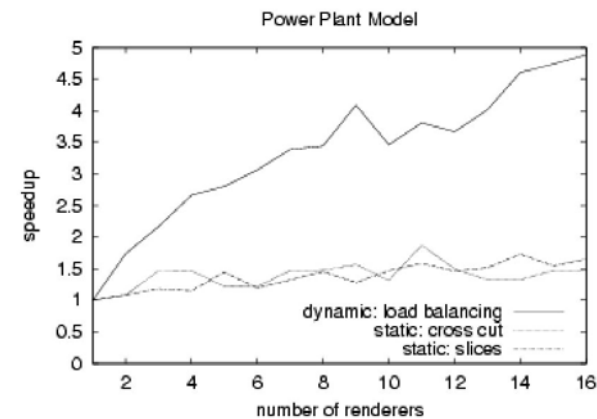
Support for Sort-First and Sort-Last

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

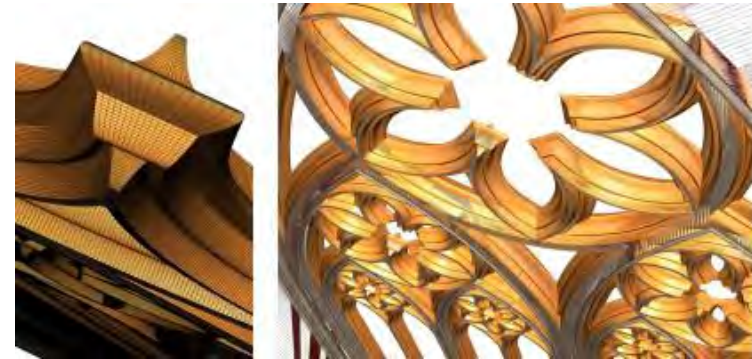
Mesh based simulator

(e.g. MassSpring, CantileverBeam, ...)

Force-Field Evaluator

Steering System

Programmable Particle System



Application example

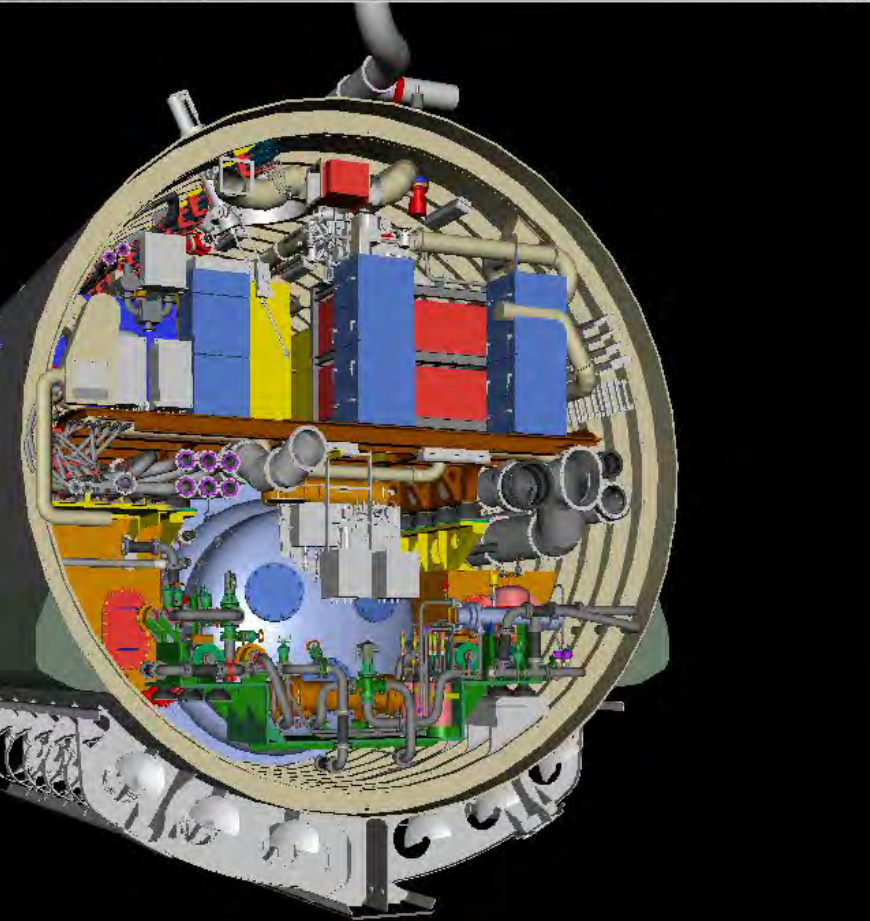


Design Review

HDW



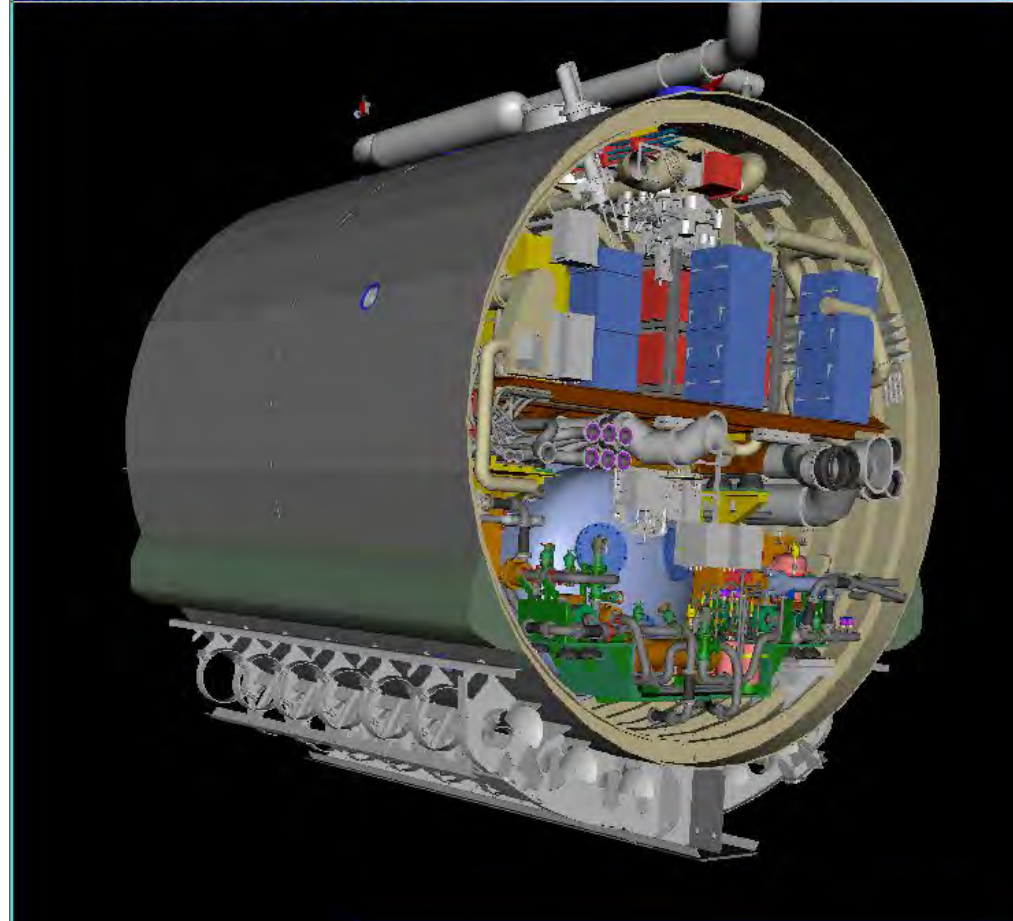
build: R-7108 Nov 13 2006



Visibility | Collision and Measuring | Clipping | Positioning

- | | | |
|---|--------------------------------------|---|
| <input type="checkbox"/> longitudinal cut | <input type="checkbox"/> lateral cut | <input type="checkbox"/> horizontal cut |
| <input type="checkbox"/> show plane | <input type="checkbox"/> show plane | <input type="checkbox"/> show plane |
| <input type="checkbox"/> mode | <input type="checkbox"/> mode | <input type="checkbox"/> mode |
| <input type="checkbox"/> clip | <input type="checkbox"/> clip | <input type="checkbox"/> clip |

Avalon: V2.0-PreAlpha build: R-7108 Nov 13 2006



Visibility | Collision and Measuring | Clipping | Positioning

- | | |
|------------------------------------|-----------------|
| <input type="checkbox"/> show/hide | |
| <input type="checkbox"/> walls | transparency: ↓ |
| <input type="checkbox"/> interior | transparency: ↓ |

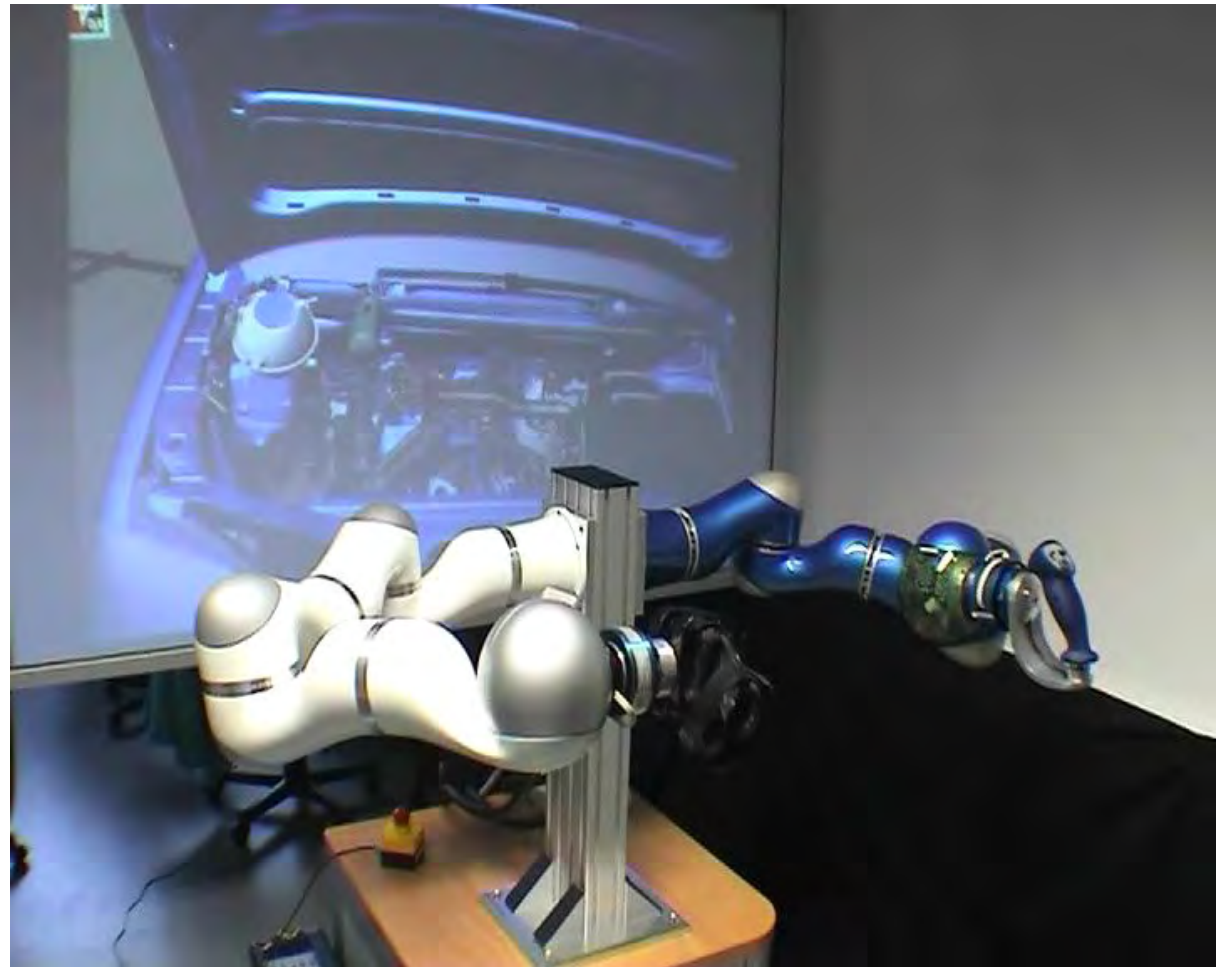
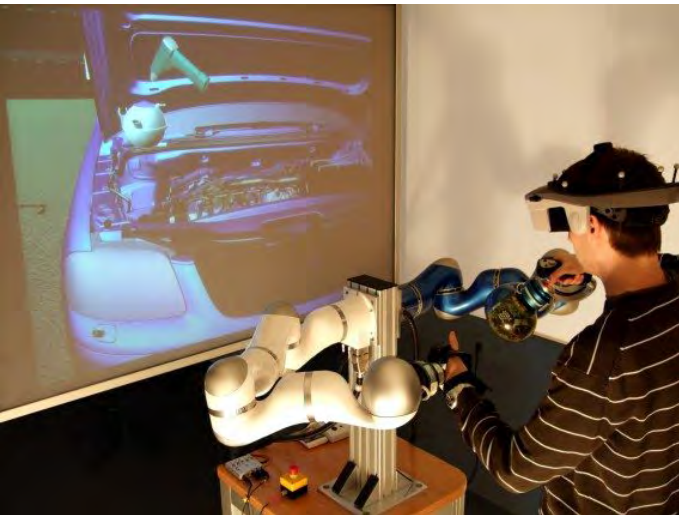
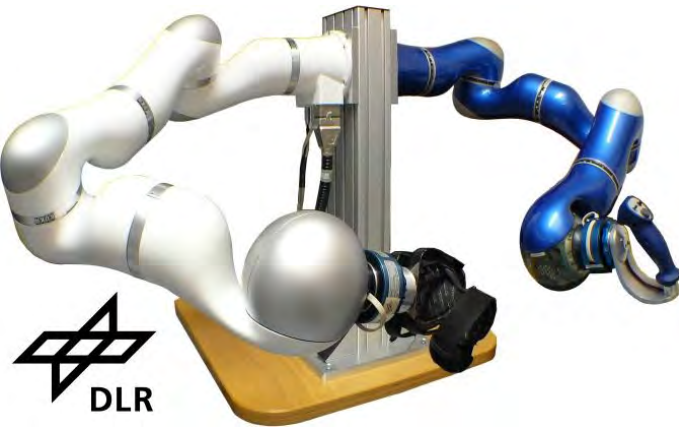
Design Reviews

VW



Assembly and Disassembly

DLR

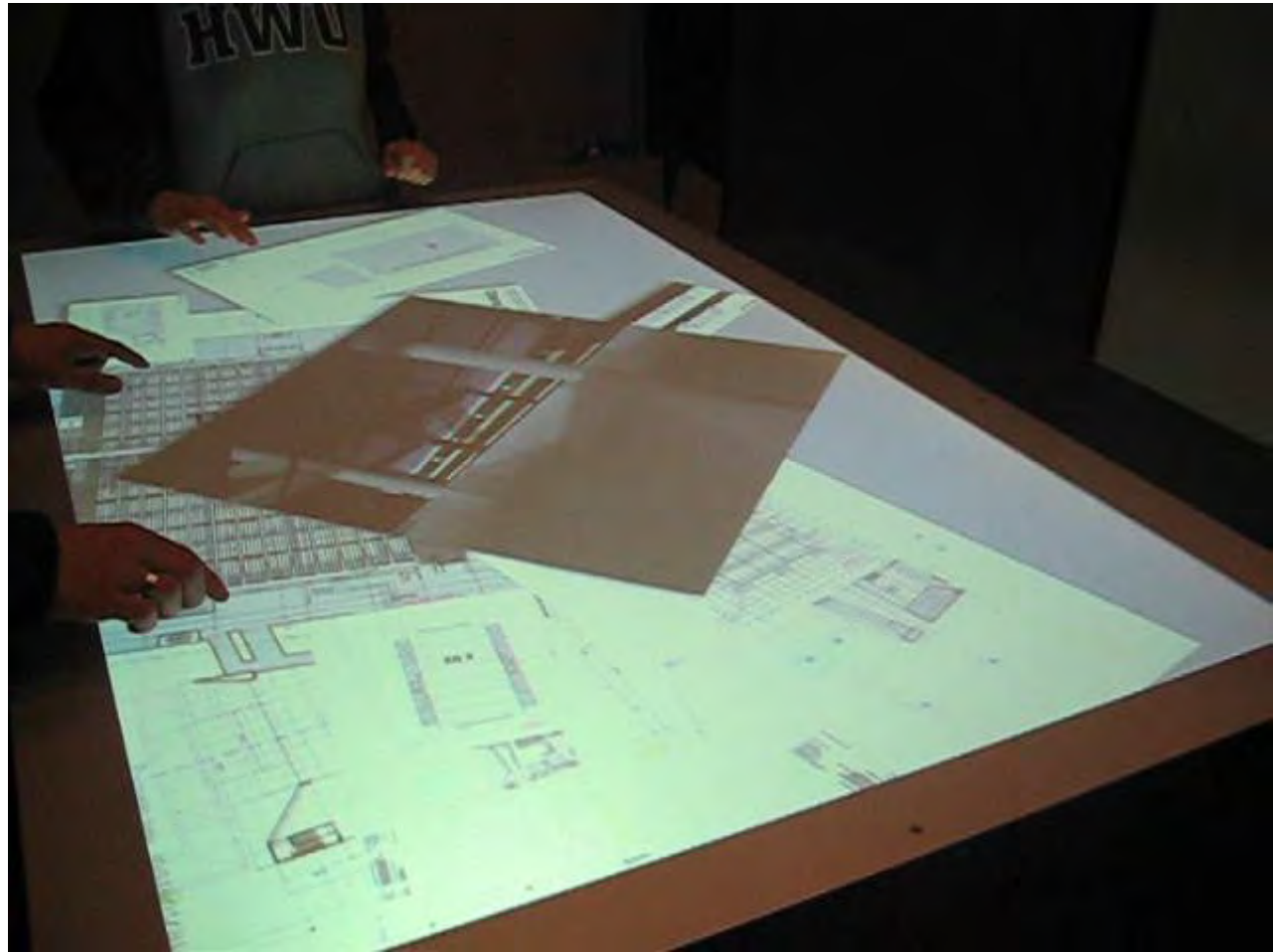
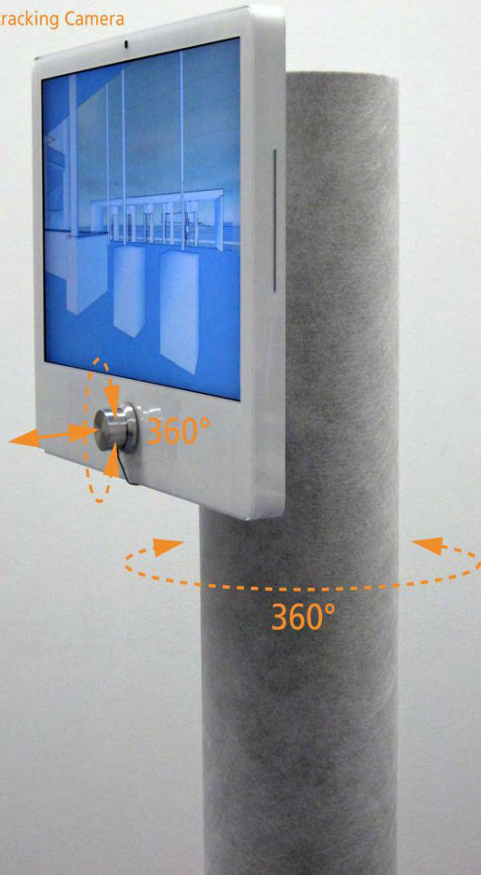


Architecture Walkthrough

Messe Frankfurt



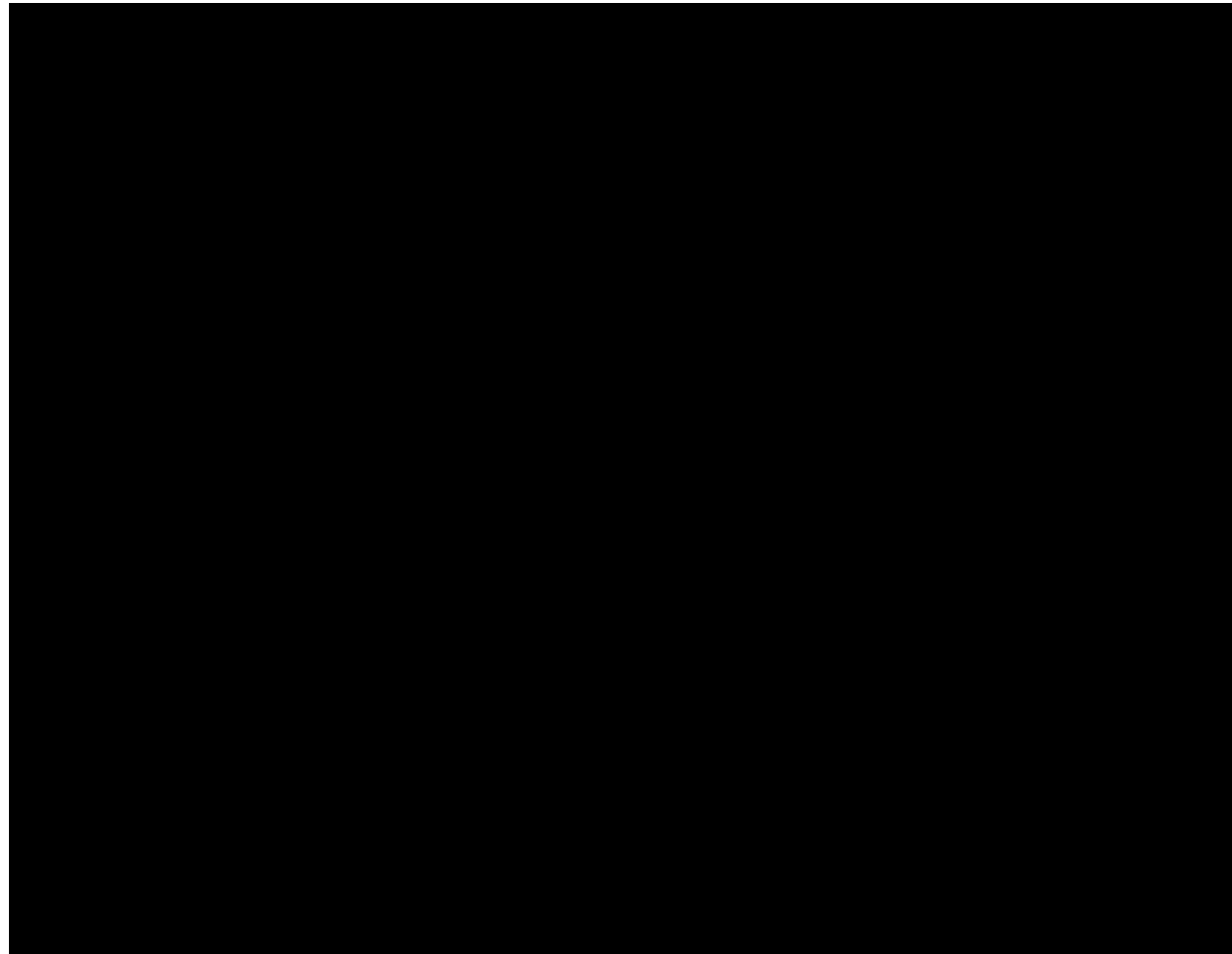
Headtracking Camera





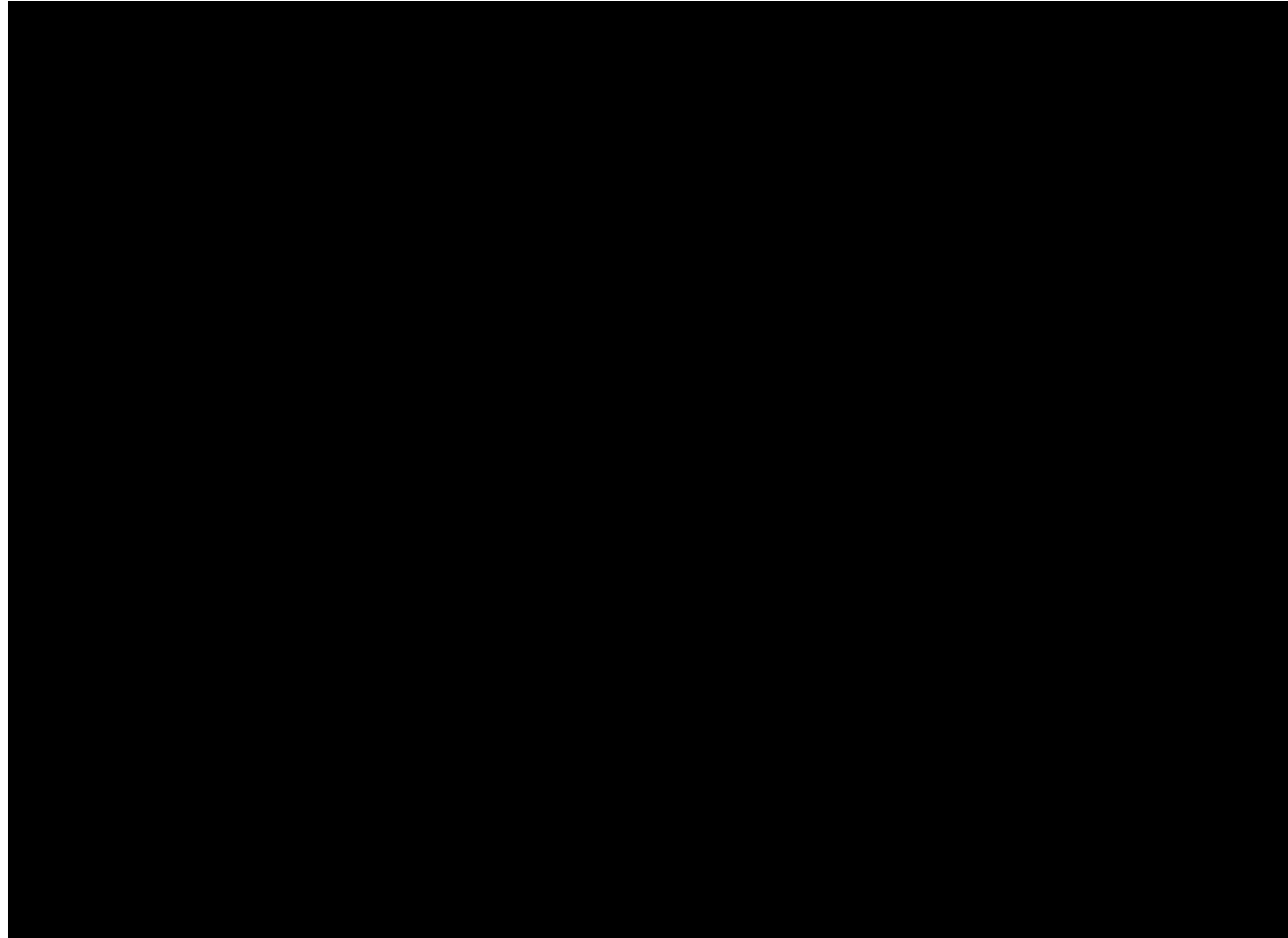
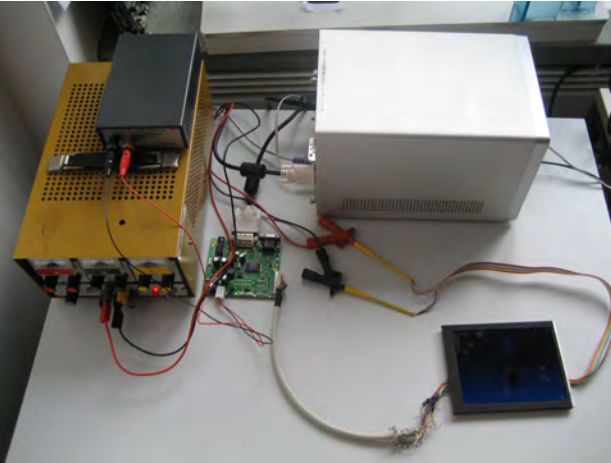
HEyeWall (35x MegaPixel wall)

Fraunhofer ZV



Virtual Car Assistant

Volkswagen AG



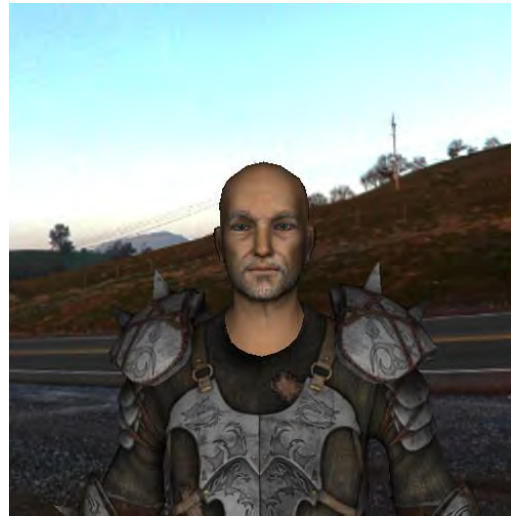
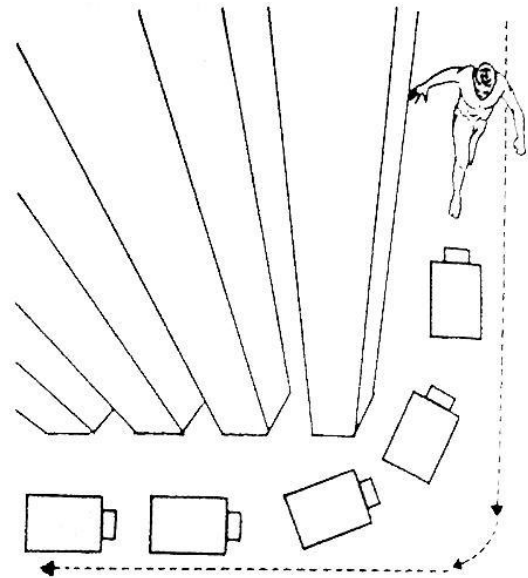
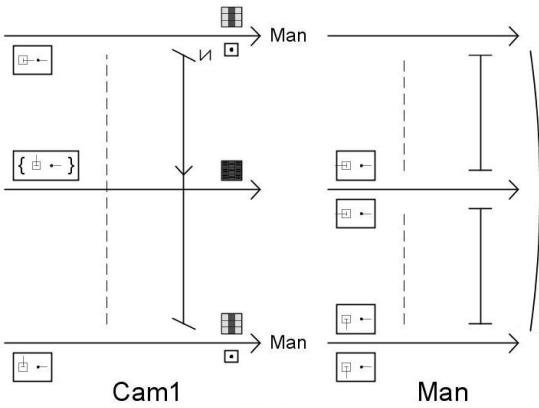
Virtual Human

BMBF



Answer

EU Project



Alignment of CAD/Real-Prototypes

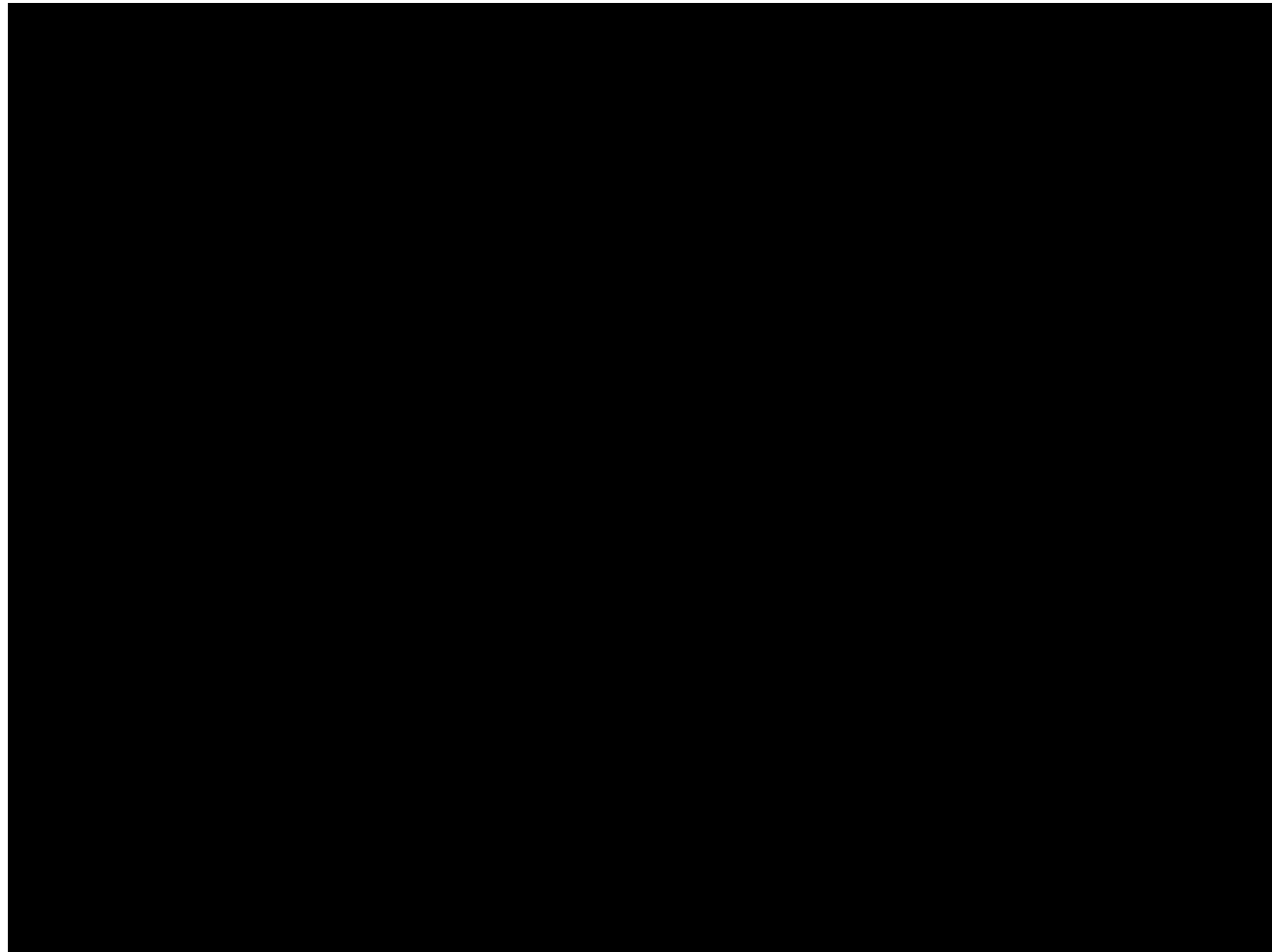
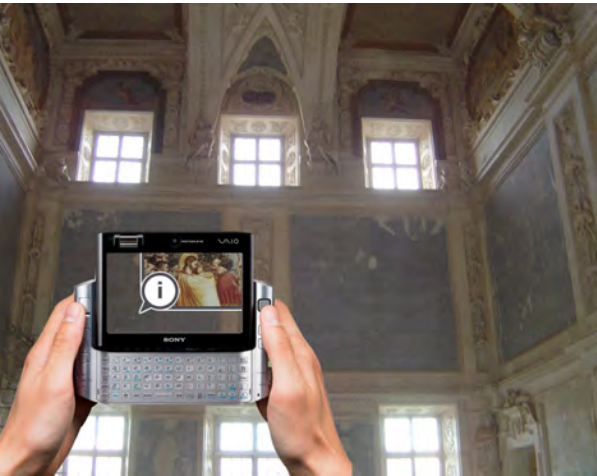
Howaldtswerke - Deutsche Werft GmbH



Camera Calibration

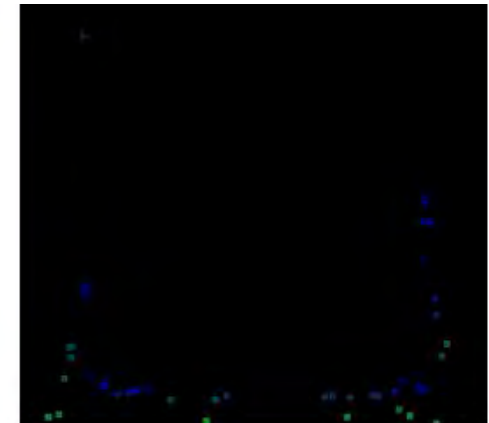
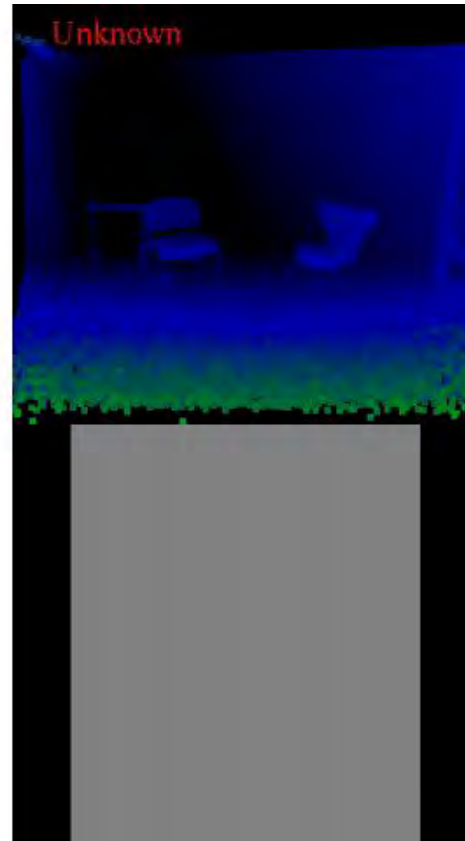
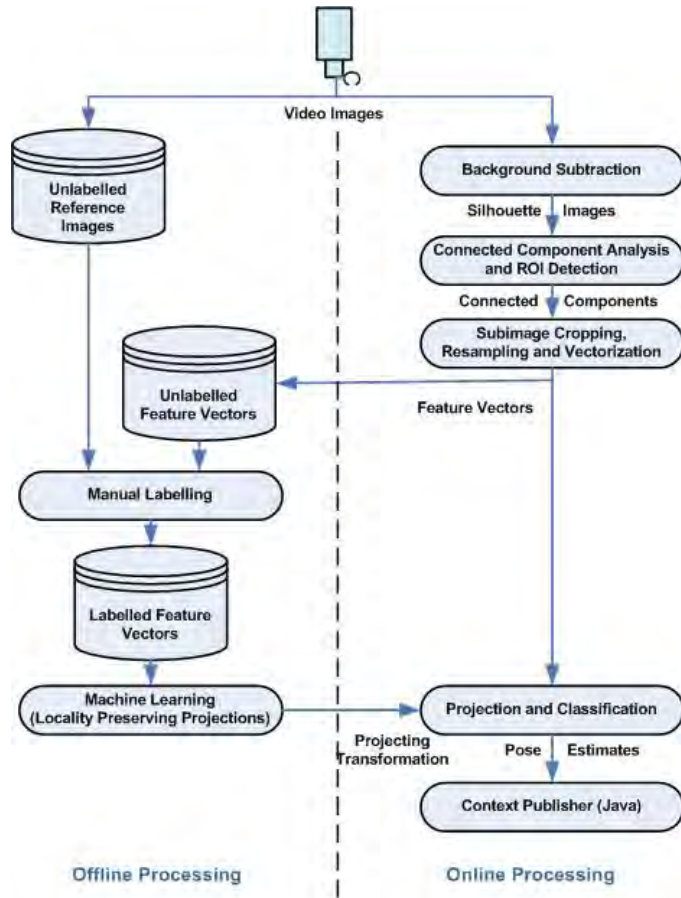
Cultural Information System

iTacitus, EU



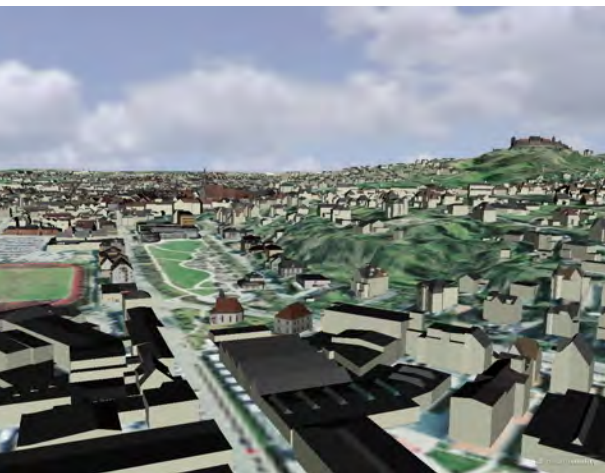
Human Posture Recognition

Persona: EU



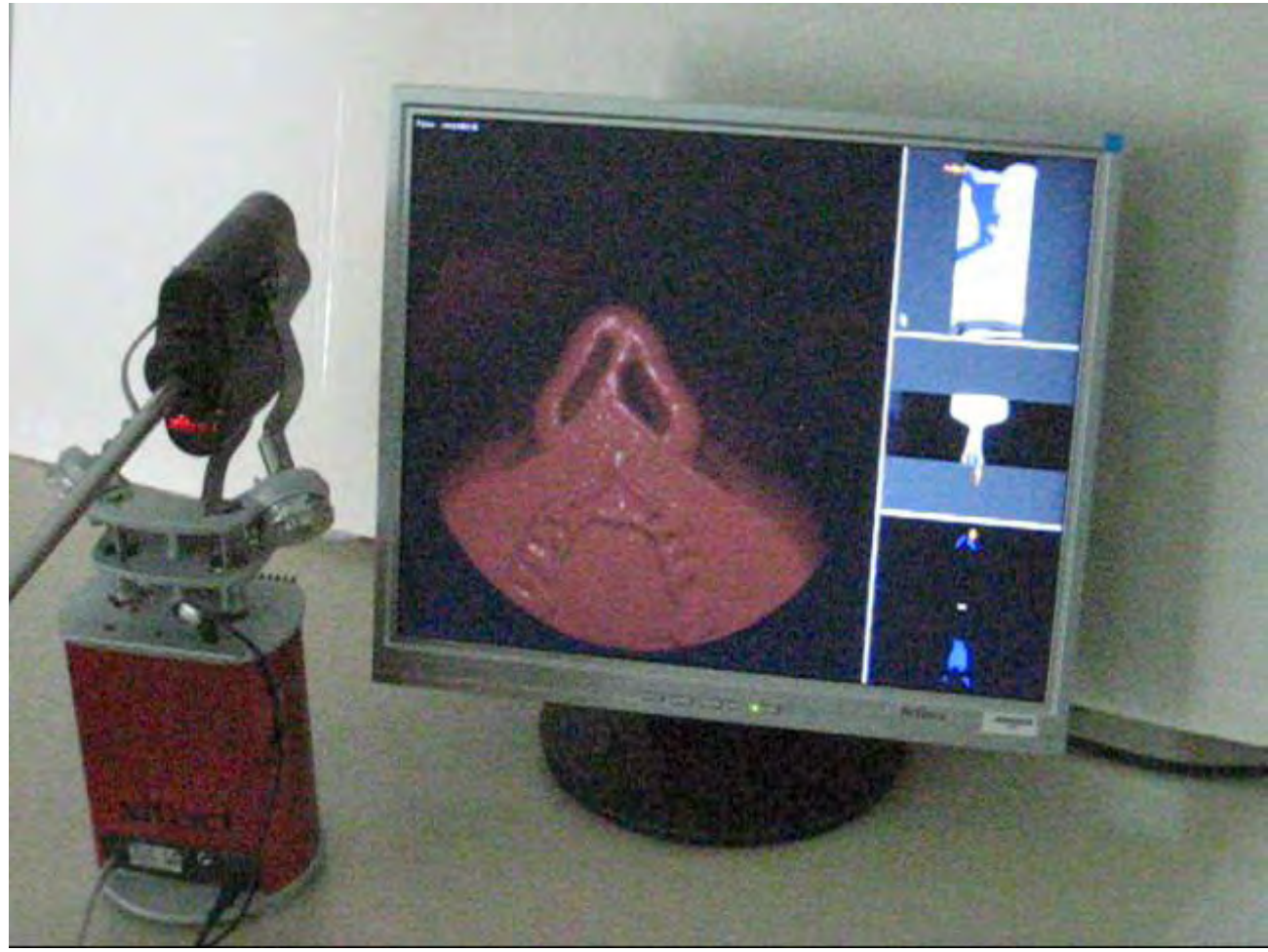
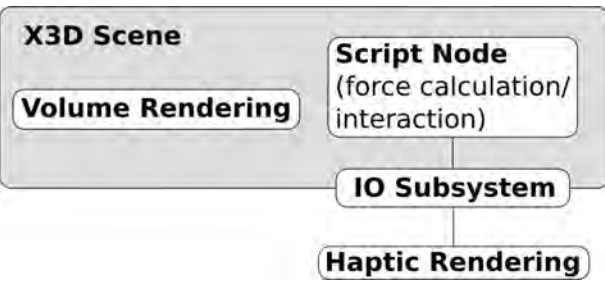
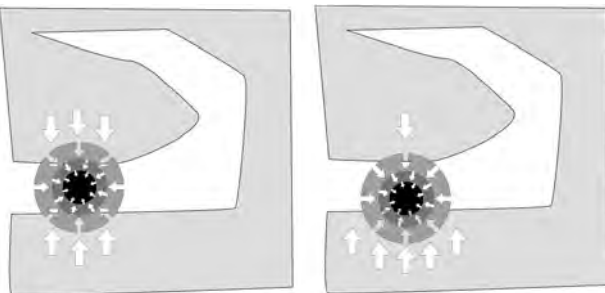
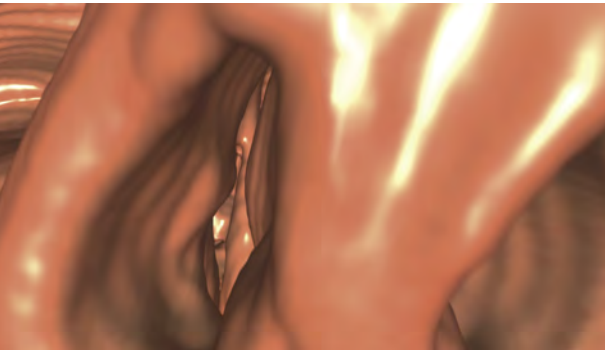
Geo Information System

Coburg IFP



Medical Training-simulator

VIVERA, BMBF

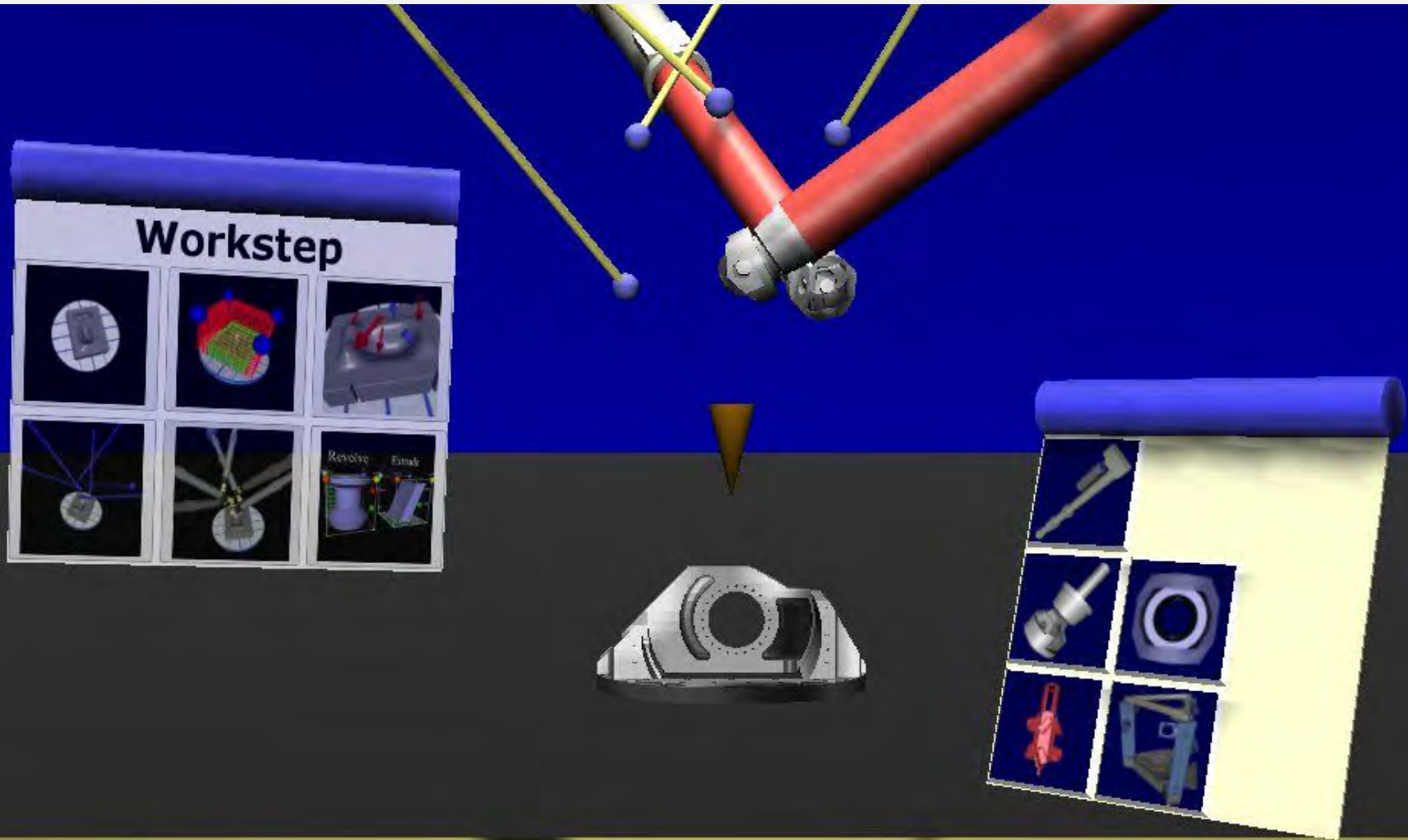


Service Control Center

SAP AG

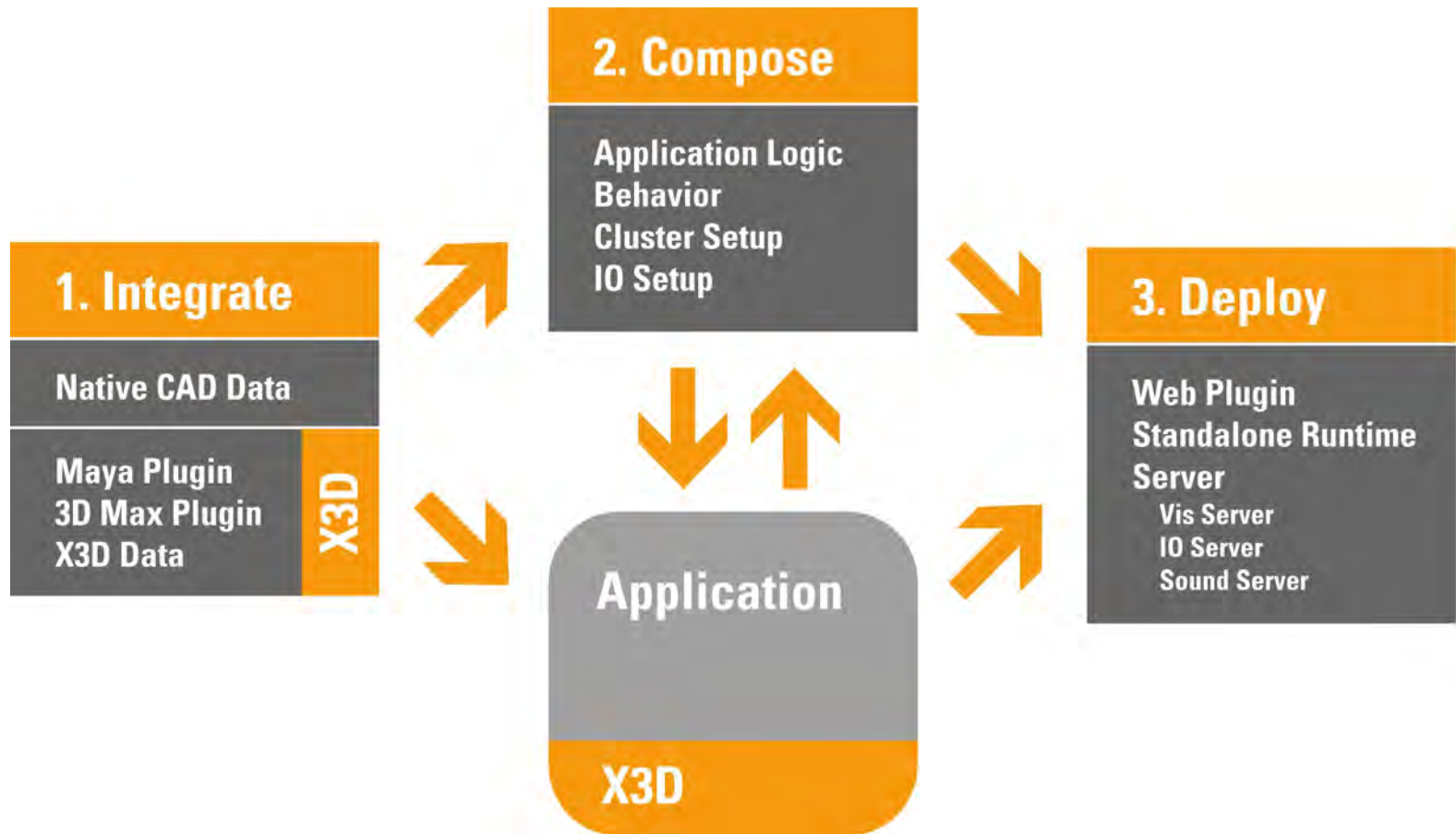


Current status and future developments



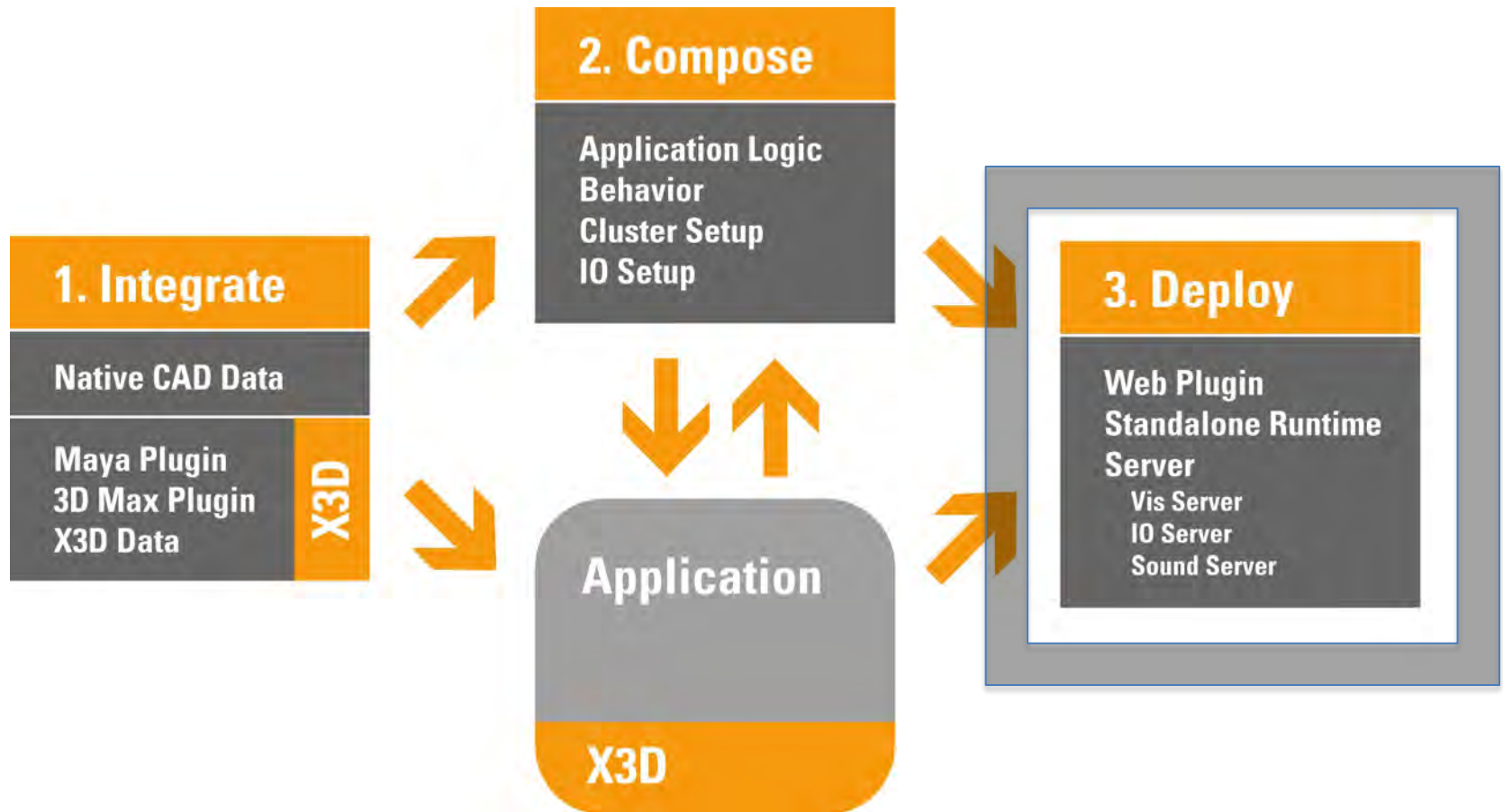
instantReality Framework

Development and Runtime-environment



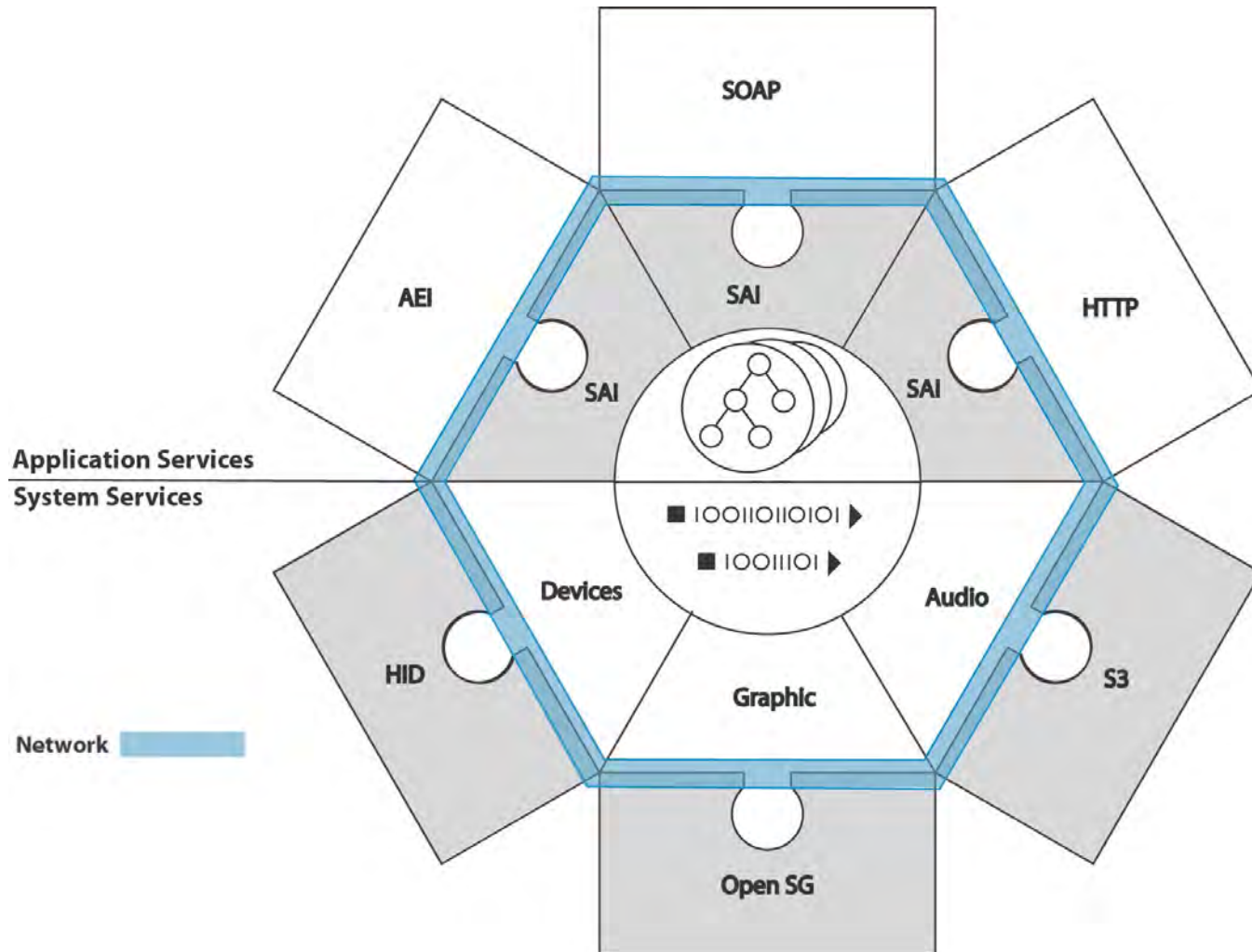
instantReality Framework

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

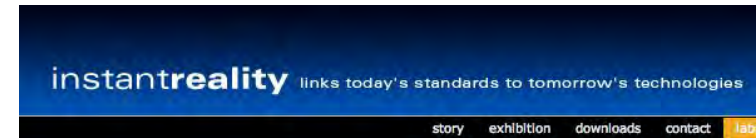


Front Pages

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

Developer Pages

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



instantreality - advanced mixed reality techn

The instantreality-framework is a high-performant system, which combines various components to provide a consistent interface for AR/VR developers. The framework was developed at the Fraunhofer IGD and ZGDV in the industry.

The framework provides a comprehensive set of tools for Virtual Reality (VR) and advanced Augmented Reality (AR). The goal was to provide a very simple application development environment including the latest research results in the field of 3D user interaction and total-immersive display design. The design includes various industry standards, like the application development and deployment.

News

SIGGRAPH 2008 class notes and slides up

Finally we updated the SIGGRAPH 2008 notes and slides for the InstantReality related class. The material can be found at www.wimps.org.

SIGGRAPH 2008 and WEB3D | 2008-08-07

Please visit us at WEB3D and SIGGRAPH. We will be at WEB3D from August 9th to 10th. At SIGGRAPH we will be at the WEB3D booth (#139). See the latest developments for iPhone, etc) and interesting demos.

Beta5 released | 2008-08-07

Beta5 has just been released for SIGGRAPH 2008. It includes 64-bit Linux support and some bugfixes. For details see the [changelog](#). **Download Beta5**

InstantMini on iPhone | 2008-08-07

At SIGGRAPH 2008 we are introducing InstantMini browser for the iPhone. Please visit us at WEB3D booth for more information.

Fix: Beta License Expired | 2008-07-01

Unfortunately the license of Beta 4 expired today.

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



DAIMLER

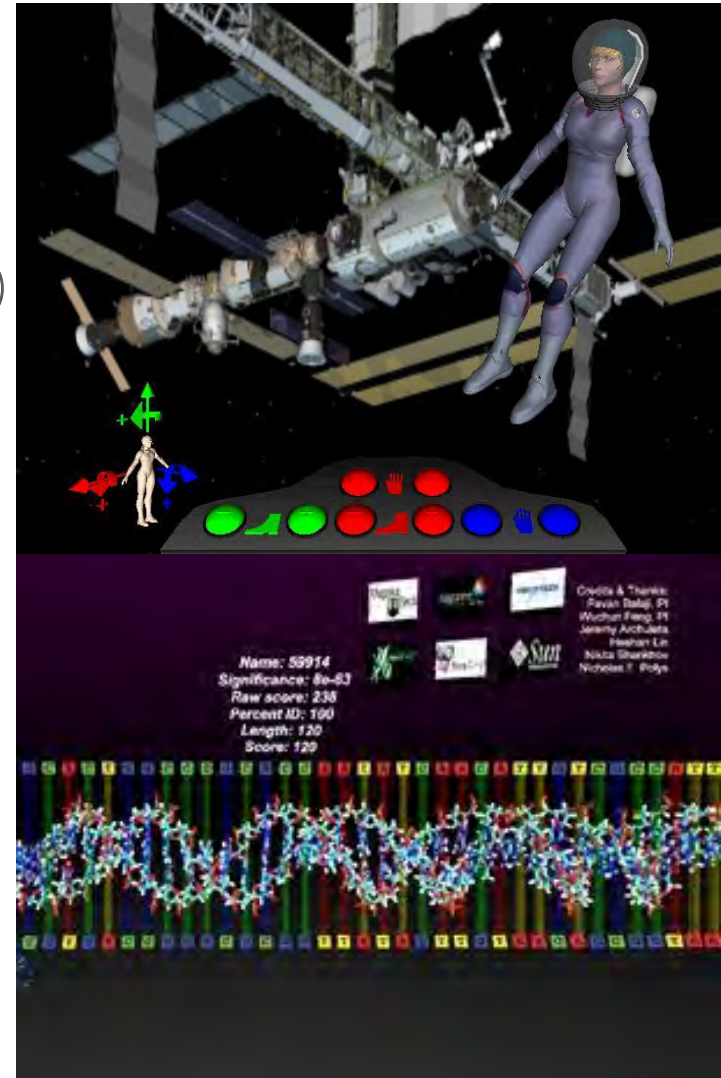


Research and Development

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

Industry

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



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

web3D

Important Dates Venue Calls Organization

Web3D 2009 SYMPOSIUM
14th International Conference on 3D Web Technology
June 16-17, 2009 at Fraunhofer Institute for Computer Graphics, Darmstadt, Germany

sponsored by: in cooperation with:

A new wave of interactive 3D applications rises from the World Wide Web. New technologies are emerging and existing technologies are evolving to enable the third dimension in web browsers. This also leads to the appearance of a new generation of consumers and producers of 3D content in the new Read-Write Web environment.

14th in the series, the Web3D 2009 International Symposium will address this wide range of topics covering 3D hypermedia on the web. The annual Web3D Symposium is a major event, which unites researchers, developers, experimenters, and content creators in a dynamic learning environment. Attendees share and explore methods of using, enhancing, and creating new 3D web and multimedia technologies, such as X3D, VRML, COLLADA, Croquet, MPEG4, Java3D, and Canvas3D. The symposium will also address new trends such as interactive 3D graphics applications on mobile devices.

Web3D 2009 will take place at [Fraunhofer Institute for Computer Graphics \(IGD\)](#) in Darmstadt (Germany) close to Frankfurt / Main. The conference is scheduled one week after [EUROVIS 2009](#) (Eurographics/IEEE Symposium on Visualization, June 10 - 12 2009) in Berlin, Germany. With only a weekend in-between this is a chance for overseas visitors to attend both

instantReality Future developments



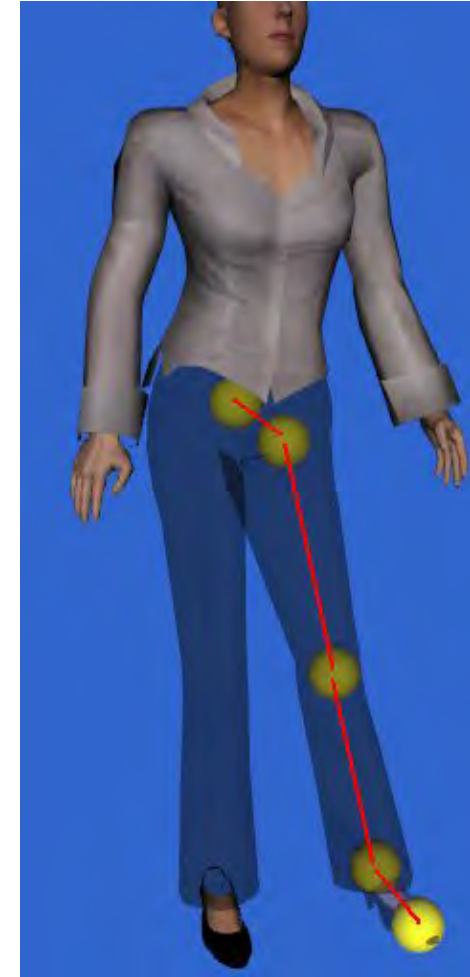
Visualisation

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

Distributed Multi-User Systems

Character Animation

Parametric Systems



Fraunhofer IGD

instantReality 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

