

VIMIT

Visualization and Interaction using Mobile and
Immersive Technology

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Overview

- Introduction & Previous Work
 - Bauhaus University of Weimar
 - Consistent Illumination AR Environments
 - Multi-Viewer Stereo Display
 - Ray-Casting of Parametric Surfaces in Real-Time
- Expose
 - VIMIT
 - Virtual Hiking Assistant
 - Efficient Rendering in Mixed Reality
 - Future Work

Bauhaus University

- Bauhaus University of Weimar
 - Founded 1921
 - 64.000 inhabitants
 - 6.000 students
- Faculties
 - Media
 - Design & Art
 - Architecture
 - Civil Engineering
- Project based Study
- Media System Science
 - Virtual Reality (Interaction)
 - Augmented Reality
 - Computer Graphics

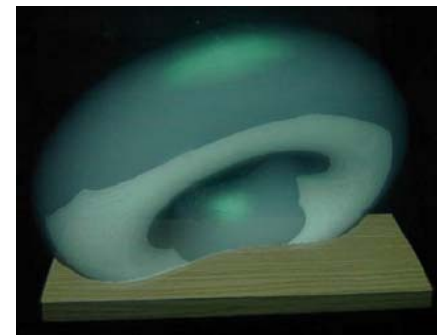


Bauhaus-
Universität
Weimar



Consistent Illumination in Augmented Reality

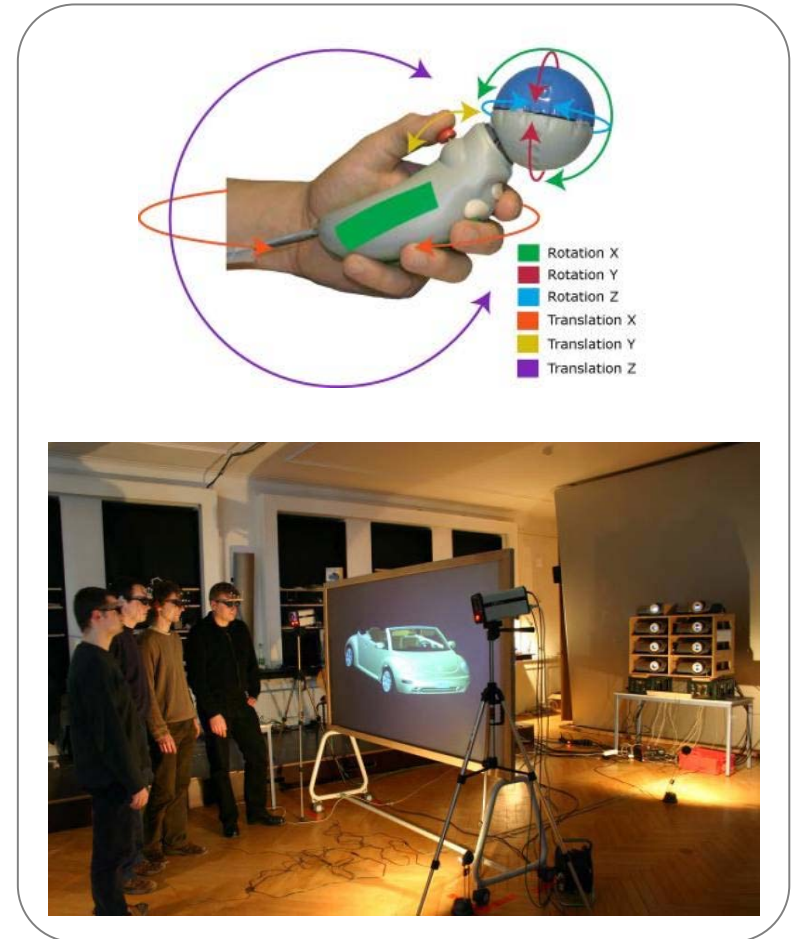
- Combinations of video projectors and cameras
- Shading, shadows and reflections between real and virtual objects



Shadows and reflections

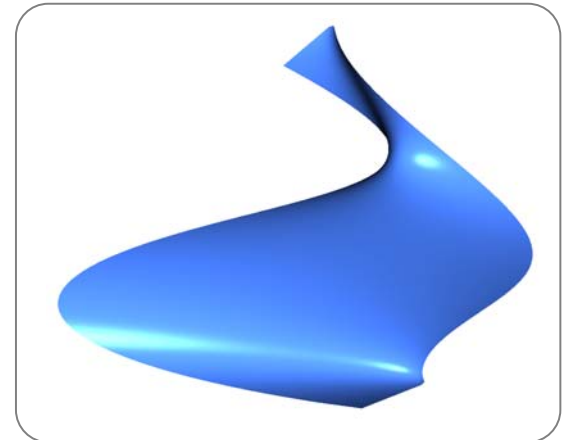
Multi-Viewer Stereo Display

- Collaborative interaction up to 4 people inside one consistent 3D virtual environment
- 8 video projectors
- Special shuttering system
- Interaction Device GlobeMouse
- Demo Application
 - Presentation at VR 2005 in Bonn

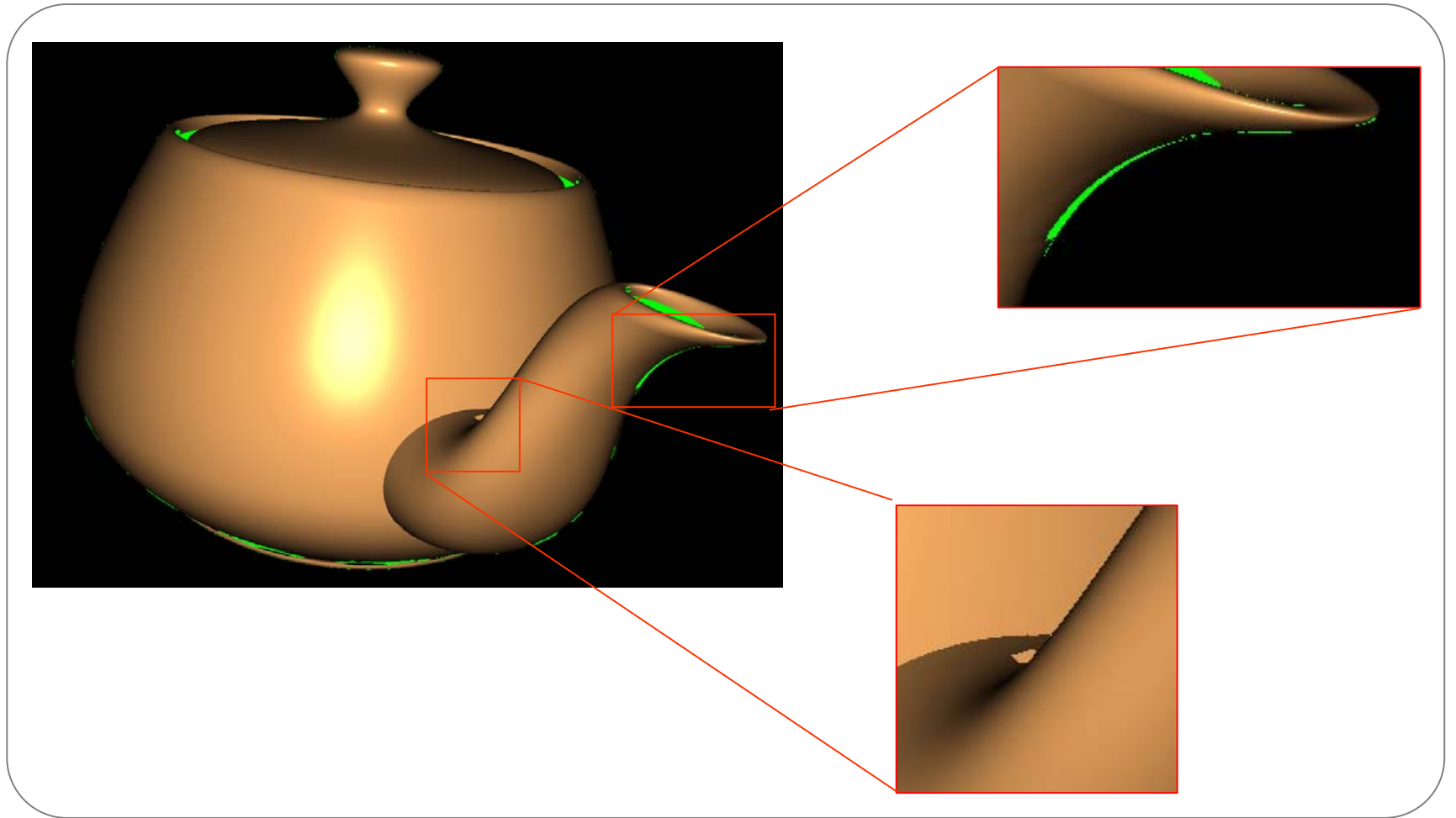


Ray-Casting of Parametric Surfaces

- Ray-Casting of parametric Surfaces in Real Time
- Parametric surfaces (Bézier- und NURBS-Surfaces)
 - standard in industrial design and CAD
 - compact representation
 - local und intuitive control
- Ray-Casting
 - Pixel precise visualization
 - Parallel computation



Artefacts



VIMIT

- Visualization and Interaction with **M**obile and **I**mmersive **T**echnologies
- Scenarios
 - Firefighter & Paramedics
 - Architecture & Civil Engineering
 - Tourism (Travel assistance)

VIMIT

- Collaboration between people in indoor and outdoor environment
 - Technology Projection Screen \leftrightarrow Handheld Device
 - Visualization Virtual Reality \leftrightarrow Augmented Reality
 - Interaction CAT \leftrightarrow Finger

VIMIT

- Technology Interior

- Hardware

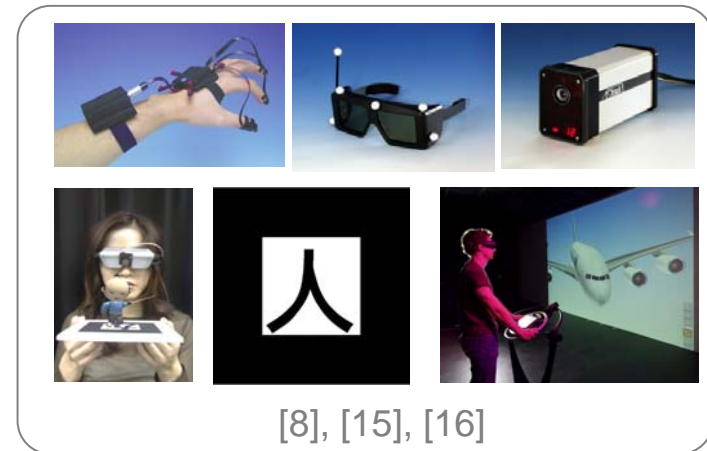
- Workstation (Cluster)
 - Notebook
 - High Definition Projection
 - mono/stereo

- Interaction

- Mouse & Keyboard, GyroMouse,
 - SpaceMouse, CubicMouse,
 - CAT, Pen or (Multi)-Finger,
 - Eyes, Brain, etc.

- Tracking

- Optical infrared Tracking
 - Magnetic
 - Inertial sensor (gyroscopes & accelerometer)
 - Marker Based
 - etc.



VIMIT

- Technology Exterior

- Hardware

- Mobile devices
(Handheld, mobile phones, UMPC)
- Notebook & Tablet PC
Small Handheld Display
- Head Mounted Display
- Retinal Display

- Interaction

- Keyboard
- Pen or Finger

- Tracking

- GPS
- Inertial sensor
(gyroscopes & accelerometer)
- Optical Tracking
- Marker Based Tracking

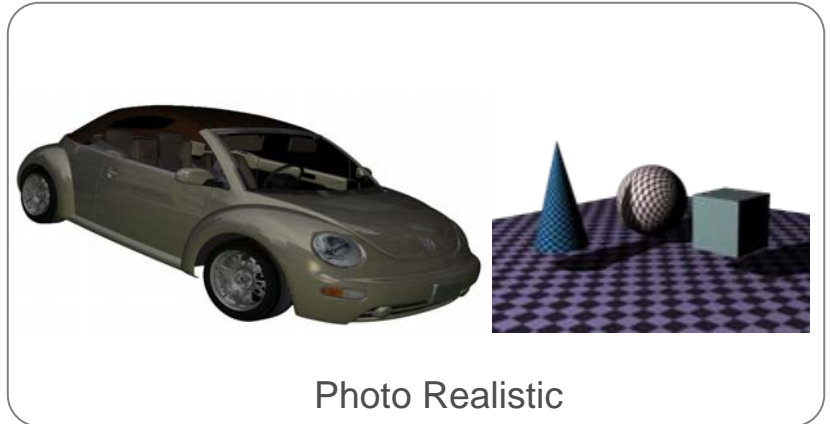


VIMIT

- Visualization

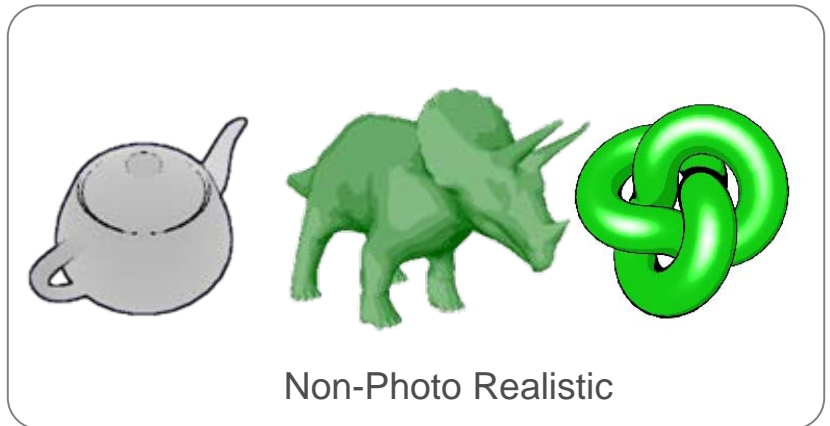
- Photo Realistic

- Shadows
 - Reflections
 - BRDF (Bidirectional Reflectance Distribution Functions)



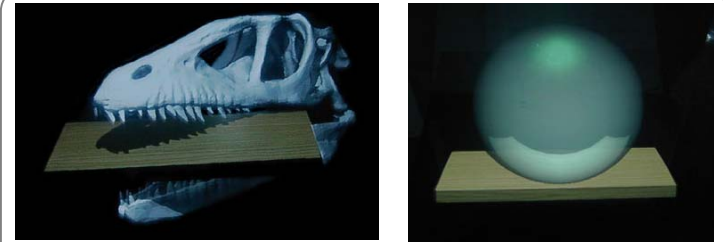
- Non – Photo Realistic

- Contour & Silhouette
 - Stylistic & Cartoon-like



Related Work – Visualization AR

- Photo realistic rendering in MR
 - Shadows and reflection between real and virtual objects
 - Bimber [1] , Madsen [5] and Naemura[6]



Shadows and reflection in MR by Bimber [1]

- Non-Photo realistic rendering in MR
 - Contour/silhouette rendering
 - Stylized or cartoon-like shading
 - Haller [4], Fischer and Bartz [3]



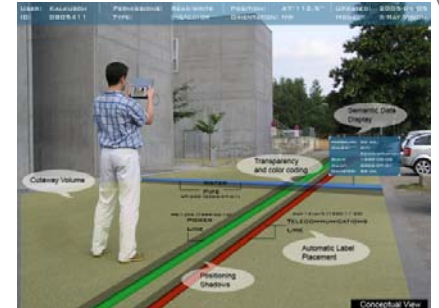
Cartoon like MR by Fischer and Bartz [3]

Related Work – Outdoor AR

- Augmented Reality with Large 3D Models on a PDA [23]
 - client/server
 - Marker based tracking
- Vidente [24]
 - graphically plastic visualization of the subsurface network of cables and pipes
- AR Scouting [21]
 - Augmented Reality Scouting for Interactive 3D Reconstruction



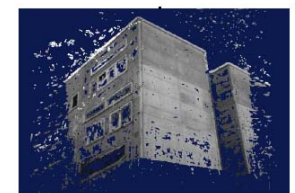
AR with large Models [23]



Vidente [24]



input image

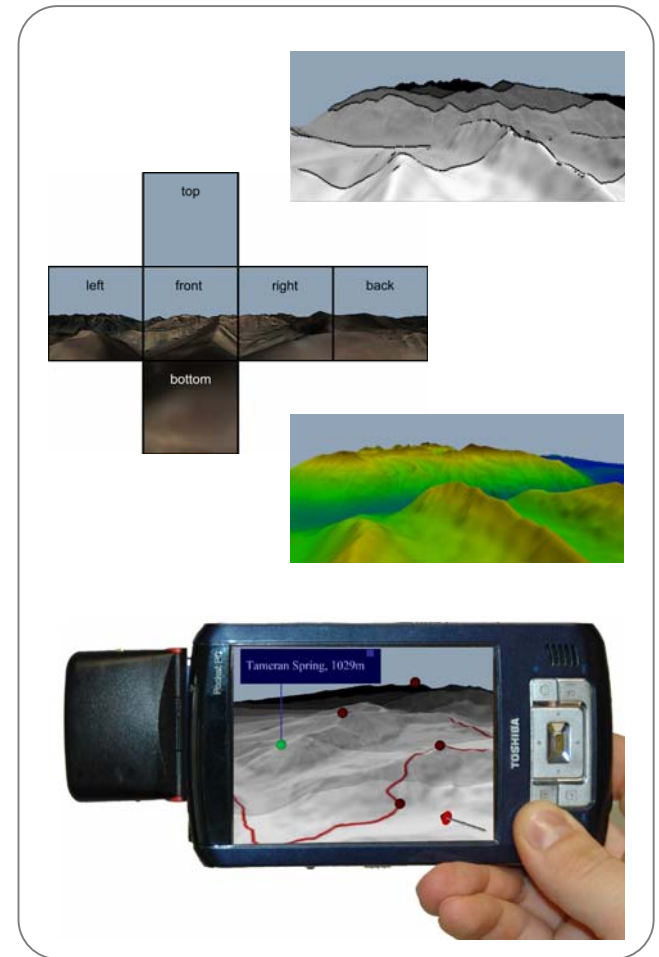


3D model

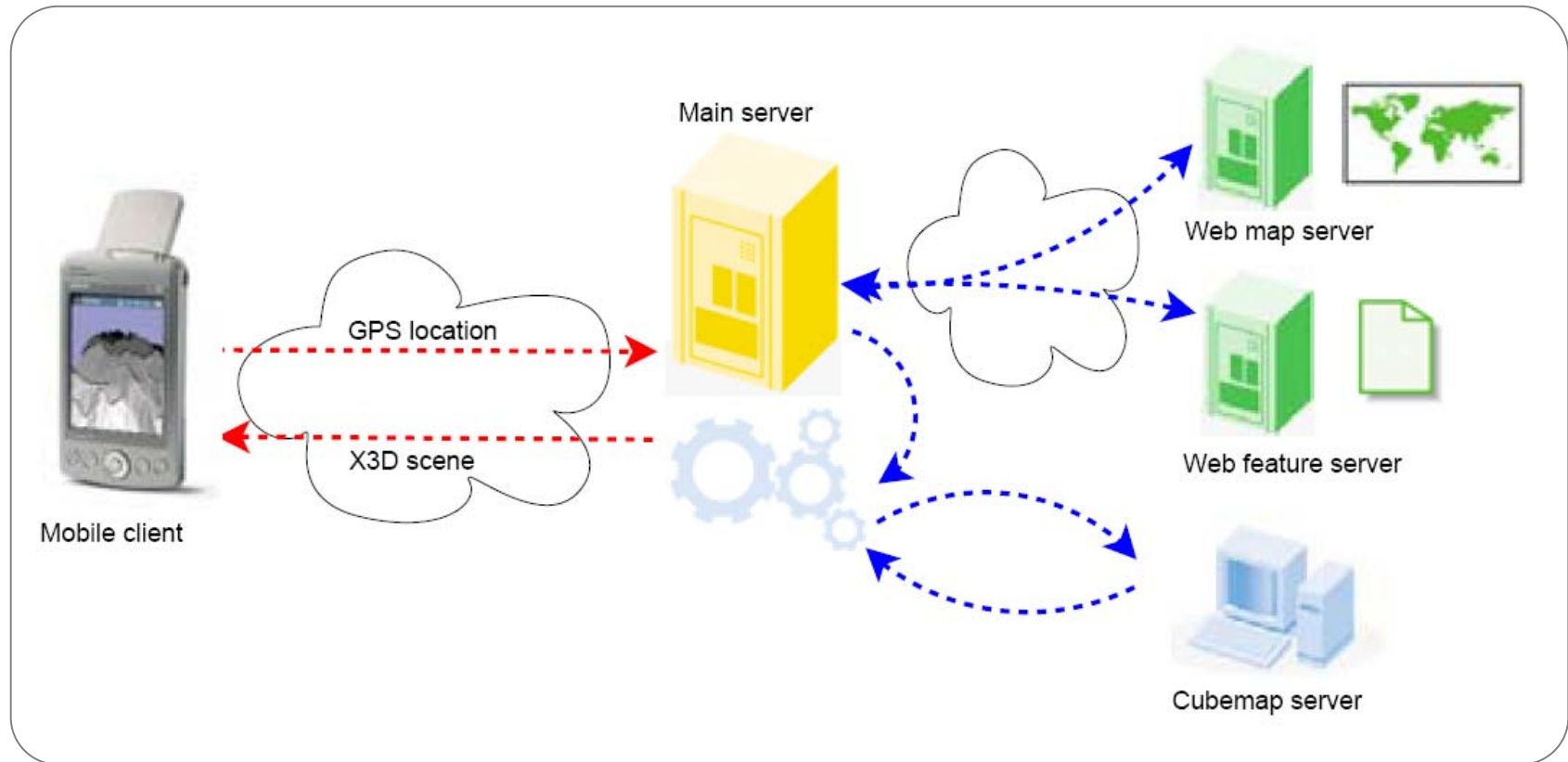
AR scouting [21]

Virtual Hiking Assistant

- 3D Panorama Service on Mobile Device for Hiking [25]
- digital assistant for mobile users like hikers and tourists
- interactive 3D panorama service
- geographical web services and non-photorealistic rendering of 3D terrains

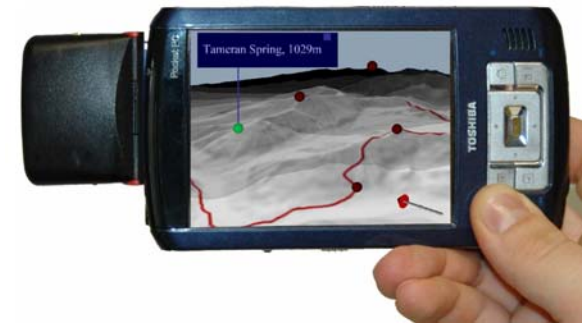


Virtual Hiking Assistant



Enhancing Mixed Reality on Mobile Devices

- Mobile devices are well suited for Mixed Reality applications
- Challenge is to obtain **one** consistent representation
- Identify rendering techniques that support the cognitive mapping
- Enhancing the Mapping between Real and Virtual World on Mobile Devices through efficient Rendering [26]



Hiking Assistant on PDA

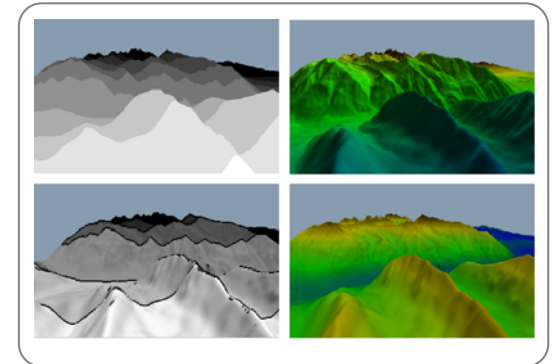


Photo-Realistic

NPR

Functional Realism

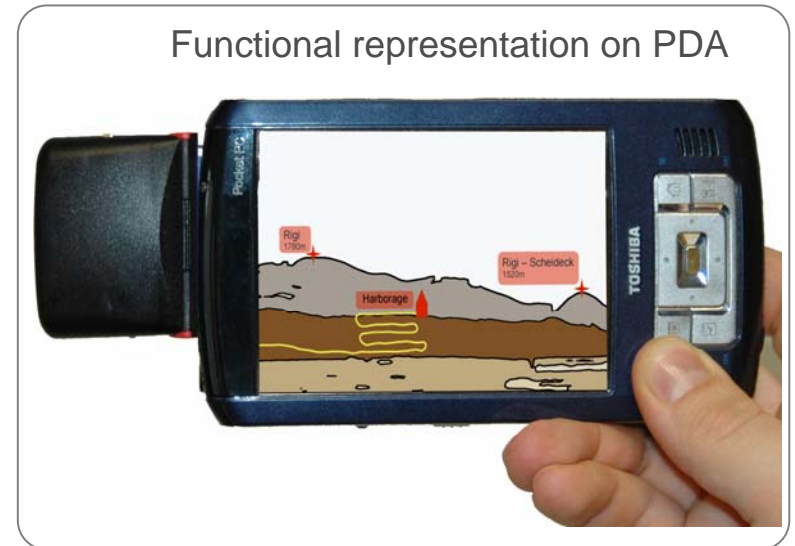
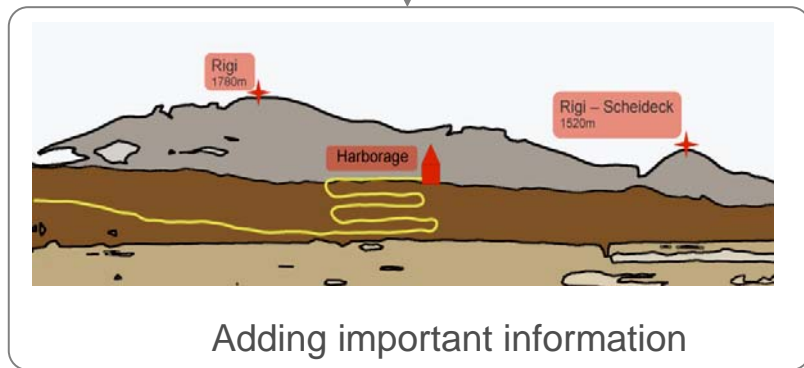
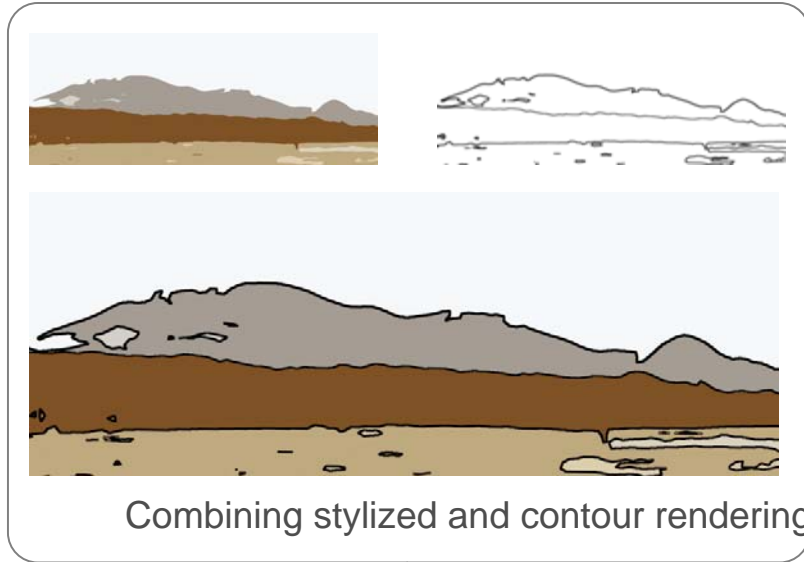
- Described by Ferwerda [3] in 2003
- preserves significant properties
 - Shapes
 - Sizes
 - Positions
- Realized using NPR rendering techniques
- Example Hiking-Assistant



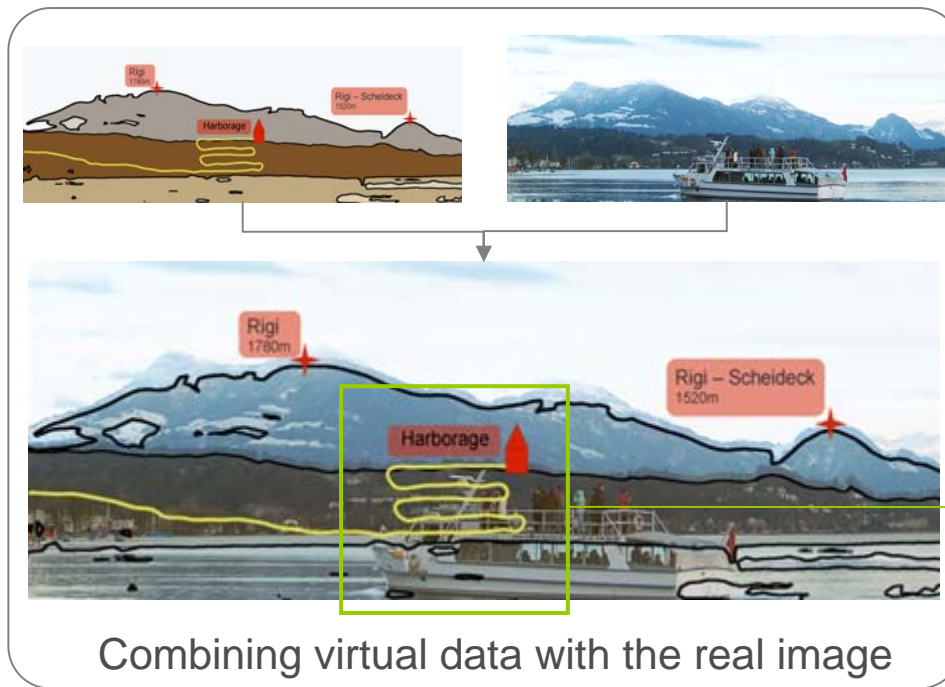
Challenge and Questions

- Create **one** consistent and convincing world
 - Still technical problems with Mobile Devices
 - GPS error up to 5m makes tracking difficult
 - No knowledge of the environment
 - Latency in data transfer (remote rendering)
 - Small screen
- Necessary to superimpose real and virtual image?
- How far can the rendering technique support the user to map the real and virtual objects by himself?

Visualization on PDA



Visualization on PDA



Disturbing occlusions

Conclusion

- Generate *functional* representations
- Identify suitable rendering techniques (NPR)
- Evaluate the techniques in an experimental setup
 - way finding task
 - task completion time
 - Sketch maps to measure goodness of cognitive mapping (Billingham [7])

Future Work

- Rendering techniques on PDA
- outdoor augmented reality is young field of research
- Challenges
 - Tracking
 - Interaction
 - Visualization
 - Collaboration between users

Merci!

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